N00217_006426
NS HUNTERS POINT, CA
SSIC 5000-33b

FINAL WORK PLAN BASEWIDE OPERATION, MAINTENANCE, AND RADIOLOGICAL SUPPORT

02/10/2022

APTIM FEDERAL SERVICES, LLC

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Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
San Diego, CA

Final
Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

February 2022

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Naval Facilities Engineering Systems Command Southwest
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San Diego, CA

Final
Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

February 2022

DCN: APTM-0006-5082-0010

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Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
San Diego, CA

Final
Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

February 2022

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Project Manager

February 10, 2022
Date

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Table of Contents

Table of Contents i
List of Appendices iii
List of Figures iii
List of Tables iv
Acronyms and Abbreviations v
1.0 Introduction 1-1
1.1 Project Organization 1-2
1.2 Work Plan Organization 1-2
2.0 Basewide Support Activities 2-1
2.1 Memorandum of Understanding 2-1
2.2 Maintenance of Radiological Controls, and Postings, and Routine Surveys 2-1
2.3 Radiological Sample Inventory and Sample Archive Maintenance 2-2
2.4 Portal Monitor Operation and Truck Wash 2-2
2.5 Radiological Support to Other Contractors 2-3
2.5.1 Radiological Awareness Briefing 2-4
2.5.2 Incoming and Outgoing Surveys 2-5
2.5.3 Radioactive Check Sources 2-5
2.5.4 Personnel Dosimetry 2-5
2.6 Waste Disposal 2-6
2.7 Work Instructions 2-6
3.0 Basewide Environmental Protection Coordination and Support 3-1
3.1 Basewide Meteorological Station 3-1
3.1.1 Meteorological Station Siting 3-1
3.1.2 Operation and Maintenance 3-2
3.1.3 Field Quality Control Procedures and Calibration Audits 3-2
3.1.4 Data Collection and Reporting 3-3
3.2 Stockpile Tracking 3-3

Table of Contents (continued)

4.0 Contractor Quality Control Plan 4-1
4.1 Quality Control Organization 4-2
4.1.1 Quality Control Personnel and Qualifications 4-2
4.1.1.1 Project Quality Control Manager 4-2
4.1.1.2 Alternate Project Quality Control Manager 4-3
4.1.2 Quality Control Directives 4-3
4.1.3 APTIM Quality Procedures 4-4
4.2 Outside Organizations 4-5
4.3 Submittal Procedures 4-5
4.4 Testing 4-5
4.4.1 Testing Plan and Log 4-6
4.4.2 Testing and Documentation 4-6
4.5 Rework Items, Non-Compliances, and Corrective Action Requests 4-6
4.5.1 Rework 4-6
4.5.2 Non-Compliances 4-7
4.5.3 Corrective Action Requests 4-7
4.5.4 Procedures for Tracking Laboratory Deficiencies 4-7
4.6 Documentation 4-7
4.6.1 Daily Reports 4-8
4.6.1.1 Daily Contractor Quality Control Report 4-8
4.6.1.2 Daily Contractor Production Report 4-8
4.6.1.3 Quality Control Specialist Report 4-9
4.6.2 Quality Control Meeting Minutes 4-9
4.6.3 Quality Control Validation 4-9
4.6.4 As-Built Drawings 4-10
4.7 Definable Features of Work 4-10

Table of Contents (continued)

4.8 Three Phases of Control 4-11
4.8.1 Preparatory Phase 4-11
4.8.1.1 Preparatory Phase Activities 4-11
4.8.2 Initial Phase 4-12
4.8.3 Follow-up Phase 4-12
4.8.4 Additional Preparatory and Initial Phases 4-13
4.9 Completion Inspections 4-13
4.9.1 Punch-Out Inspection 4-13
4.9.2 Pre-Final Inspection 4-13
4.9.3 Final Acceptance Inspection 4-14
4.9.4 Inspection Documentation 4-14
5.0 References 5-1

List of Appendices

Appendix A: Waste Management Plan A-1
Appendix B: Abbreviated Sampling and Analysis Plan (dated December 2021) B-1
Appendix C: HPNS Basewide Stockpile Inventory (as of January 1, 2021) C-1
Appendix D: Project Work Instructions D-1
Appendix E: Project Quality Control Manager and Alternative Project Quality Control Manager Letters of Designation E-1

List of Figures

Figure 1: Radiological Areas Under Contract (February 12, 2021)
Figure 2: Organization Chart
Figure 3: Meterological Station Siting

List of Tables

Table 1: Siting and Exposure for Meteorological Sensors

Table 2: Meteorological Station Measurement Quality Objectives

Table 3: Meteorological Station Verification/Calibration and Accuracy Criteria

Table 4: Project Quality Control Duties and Responsibilities

Table 5: Outside Organizations

Table 6: Submittal Register

Table 7: Testing Plan and Log

Table 8: Definable Features of Work Matrix

Table 9: Organization and Personnel Certifications Log

Acronyms and Abbreviations

AMS ..... *APTIM Management System*
APTIM ..... Aptim Federal Services, LLC
COR ..... Contracting Officer Representative
CQC ..... contractor quality control
CTO ..... contract task order
DFOW ..... definable feature of work
EPA ..... U.S. Environmental Protection Agency
HPNS ..... Hunters Point Naval Shipyard
IR ..... Installation Restoration
KO ..... Contracting Officer
LLRW ..... low-level radioactive waste
MOU ..... Memorandum of Understanding
Navy ..... U.S. Department of the Navy
O&M ..... operation and maintenance
PM ..... project manager
QCD ..... quality control directive
RASO ..... Radiological Affairs Support Office
RCT ..... radiological control technician
RPP ..... *Radiation Protection Plan, Basewide Operation, Maintenance and Radiological Support, Former Hunters Point Naval Shipyard, San Francisco, California*
RSY ..... radiological screening yard
RWP ..... radiological work permit
QC ..... quality control

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1.0 Introduction

Aptim Federal Services, LLC (APTIM) has been contracted by the Naval Facilities Engineering Command Southwest to provide basewide radiological support and basewide environmental protection coordination and support at Hunters Point Naval Shipyard (HPNS), located in San Francisco, California (Figure 1). Radiological support will be performed under APTIM's U.S. Nuclear Regulatory Commission License 20-31389-30 and California Agreement State License Broad Scope Radioactive Material License 7889-07. APTIM will maintain radiological controls and postings throughout the base, ensure radiation protection to those at the base, and support other contractors completing chemical removal and remediation work in radiologically impacted areas. APTIM will also provide air monitoring and stormwater support, including providing oversight and observation and installation and operation and maintenance (O&M) of a meteorological station.

The work presented herein is authorized under the U.S. Department of the Navy (Navy) Contract No. N62473-17-D-0006, Contract Task Order (CTO) N6247321F5082. This work plan describes the technical approach that will be implemented to provide basewide radiological support according to the Navy Statement of Work. In general, basewide radiological support includes the following:

- Performing routine surveys of radiologically impacted buildings and sites
- Maintaining basewide radiological postings and controls for radiologically impacted areas and radiological work areas
- Providing site-specific radiological training for visitors or contractors working in radiologically impacted areas
- Providing radiological screening and sampling to contractors performing non-radiological work in a radiologically impacted site
- O&M of a radiological portal monitor and tire truck wash for incoming and outgoing trucks
- Other support activities to be performed as needed

In general, basewide environmental protection coordination and support includes the following:

- Oversight of environmental controls, such as dust management and stormwater protection

- Install and maintain a basewide meteorological station and coordinate to allow other contractors access to meteorological data
- Maintain and inspect stockpiles located inside radiological areas

Work performed under this work plan will follow the provisions of the *Radiation Protection Plan, Basewide Operation, Maintenance and Radiological Support, Former Hunters Point Naval Shipyard, San Francisco, California* (RPP; APTIM 2021a) and the project *Accident Prevention Plan, Basewide Operation, Maintenance and Radiological Support, Former Hunters Point Naval Shipyard, San Francisco, California* (APTIM, 2021b).

1.1 Project Organization

Figure 2 presents the project organization and APTIM points of contact for this project.

1.2 Work Plan Organization

This work plan is organized into the following sections and appendices:

- Section 1.0, “Introduction”—Provides the project team organization, project schedule, and work plan organization.
- Section 2.0, “Basewide Support Activities”—Provides an overview of planned support activities.
- Section 3.0, “Basewide Environmental Protection Coordination and Support”—Provides an overview of planned suport activities.
- Section 4.0, “Contractor Quality Control Plan”—Outlines quality control (QC) procedures for the project.
- Section 5.0, “References”—Includes a list of documents used to compile this Work Plan.
- Appendix A, “Waste Management Plan”—Describes the waste sampling design and rationale; laboratory analyses; sampling methods and locations; and sample frequency.
- Appendix B, “Abbreviated Sampling and Analysis Plan”—Addresses the specific analytical requirements for soil and water samples required to support non-radiological contractors.
- Appendix C, “HPNS Basewide Stockpile Inventory (as of January 1, 2021).”

- Appendix D, “Project Work Instructions”—Includes current and relevant project work instructions that have been prepared for the basewide radiological support task.
- Appendix E, “Project Quality Control Manager and Alternative Project Quality Control Manager Letters of Designation”—Includes letters of designation for the Project Quality Control Manager and the Alternative Project Quality Control Manager.

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2.0 Basewide Support Activities

The following subsections summarize the radiological support activities to be performed for CTO N6247321F5082. Detailed information on the procedures described in the following subsections is provided in the appendices as noted.

2.1 Memorandum of Understanding

A Memorandum of Understanding (MOU) among the contractors working on radiologically controlled sites at HPNS helps to define APTIM's role and responsibilities for basewide radiological support under this task order. Figure 1 depicts the current radiological areas under contract. The MOU will be revised and updated if radiological boundaries change or individual radiological contractor responsibilities change.

2.2 Maintenance of Radiological Controls, and Postings, and Routine Surveys

APTIM will implement and maintain radiological controls for radiologically impacted areas that are not covered by an on-site radiological remediation contractor according to the current MOU, which will be posted within the on-site trailer. Sites will be posted according to existing radiological conditions. Radiological postings will be placed and maintained every 15 meters along perimeter fencing for radiologically impacted sites. Postings and fencing will be inspected on a minimum quarterly basis. Additional fencing will be procured and set up as needed.

Radiological controls and postings are further described in Section 14 of the RPP (APTIM, 2021a) and *APTIM Management System* (AMS) procedure AMS-710-07-WI-04015, "Radiological Labeling, Postings, and Access Control" (APTIM, 2022).

APTIM will assume the radiological controls of the following areas:

- Radiological Screening Yard (RSY) 3 in Parcel E
- Installation Restoration (IR)-02 and IR-03
- IR-12 (Salvage Yard)
- Building 258 Sample Storage Areas
- Trevet Bulk Storage Tank (Baker Tank)

- Portal Monitor
- Area near Buildings 204/205 between Dry Docks 2 and 3

Changes (additions or removals) to the list above will be documented in an updated MOU.

Routine weekly, monthly, and quarterly surface surveys will be performed for those areas that are radiologically impacted at HPNS, but not currently controlled by another licensed radiological contractor. Surface surveys will cover radionuclides of concern for each site. Survey activities include dose monitoring, and the collection of swipe samples and static measurements. The main purpose of the surveys is to ensure that there is no change in dose reading at the perimeter that could negatively impact the public or environment and to ensure security measures are in place. Routine surveys are discussed further in the RPP (APTIM, 2021a) and will be documented in a project work instruction. Routine surveys include building surfaces and land areas.

2.3 Radiological Sample Inventory and Sample Archive Maintenance

Radiological samples are currently archived in Building 258 in two secure fenced areas. In addition to preserving, managing, and maintaining the area, APTIM will inventory and archive new samples as they are received in accordance with Work Instruction D0006-4550-012, “Inventory and Archiving of Historical Radiological Soil Samples at Hunters Point Naval Shipyard” (Appendix D). Samples will be stored to allow for retrieval for reanalysis if requested by the Navy.

2.4 Portal Monitor Operation and Truck Wash

APTIM will maintain and operate the portal monitor (Ludlum Model 3500-1000) for incoming and outgoing trucks loaded with both radiologically and non-radiologically contaminated soil and debris. The purpose of the portal monitor scan is to prevent the inadvertent shipment of materials or equipment exhibiting elevated radiation levels on to or off of HPNS. Hand screening may be required in instances when the portal monitor malfunctions or is unavailable. Portal monitor and supplemental hand surveys will be conducted in accordance with work instruction D2005-0008-003, “Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation” (Appendix D). Loads that fail the portal monitor or hand scan will be escorted by a radiological control technician (RCT) back to the contractor who generated the soil or will be dumped and radiologically screened in a radiologically controlled area. After the materials are

offloaded, trucks will be scanned upon exiting the impacted area, and the empty truck will be re-run through the portal monitor. If the truck does not alarm the portal monitor, it is free to return to service. Further steps for screening trucks that fail the portal monitor are provided in the work instruction (Appendix D). Additionally, the Base Realignment and Closure Caretaker Site Office Activity point of contact, the Navy Remedial Project Manager, and Radiological Affairs Support Office (RASO) will be notified immediately (same day) if a load fails. A project work instruction for the portal monitor is included as Appendix D.

APTIM will provide a monthly summary report of the portal monitor usage and activities. The report will include the origin of the load, information whether the load passed or failed the portal monitor and support hand screening documentation (if necessary), and a quantification of net increase in portal monitor alarms as compared to the previous month.

APTIM will maintain a truck wash during large-scale hauling events. The truck wash will be operated in conjuncture with operation of the portal monitor and will help reduce truck track-out. If the truck wash is not operational or during periods of minimal waste hauling, truck tires may be hand-spray to remove dirt and dust instead.

2.5 Radiological Support to Other Contractors

Prior to providing radiological support to other contractors, the Radiation Safety Officer will review the proposed scope of work and determine the level of effort needed by APTIM to provide coverage for the work activities. The Radiation Safety Officer will identify potential radionuclides of concern for the work area and determine the appropriate level of control. APTIM will develop project work instructions as needed and submit to Navy for review and concurrence prior to the start of fieldwork.

Radiological support and supervision of non-radiological contractors performing work in radiologically impacted areas (Figure 1) that are not currently under the license control of another contractor will be provided by qualified APTIM RCTs. At a minimum, the support includes radiological training and escort into and out of an impacted area. The RCT assigned to this task must ensure personnel entering and exiting the impacted areas are properly trained, briefed, supervised, and scanned for radiological contamination upon exiting the site per U.S. Nuclear Regulatory Commission license requirements. Additionally, if the contractor is performing intrusive work, surveys of equipment may be required during work efforts.

APTIM will perform radiological sampling and procure third-party laboratory analysis (as required) in the event that a non-radiological contractor has to perform intrusive activities in an impacted area. Prior to the start of fieldwork, the contractor will submit their scope of work for review and APTIM will develop project work instructions, which will be reviewed by the Navy prior to the start of fieldwork. Details on the soil sampling approach and analyses are provided in Appendix A (Waste Management Plan), Appendix B (Abbreviated Sampling and Analysis Plan), and/or summarized in task-specific work instructions.

APTIM will implement task-specific tailgate briefings for assigned tasks which will be led by the Project Radiological Safety Officer Representative and provide an opportunity for both radiological technicians and field personnel to ask questions. APTIM will work closely with the Navy and other HPNS contractors to forecast upcoming field needs, field scheduling, and training at HPNS. APTIM will organize and facilitate weekly field calls with the Navy during periods of increased fieldwork.

2.5.1 Radiological Awareness Briefing

APTIM will conduct radiological awareness briefings for non-radiological remediation contractors executing work in radiologically impacted areas and requiring an escort. Briefings will be specific to the area(s) of concern where access is needed, but will cover the following at a minimum:

- Applicable portions of Title 10 Code of Federal Regulations 19, Title 10 Code of Federal Regulations 20, the RPP (APTIM, 2021a), radiological work permits (RWPs), site-specific reference documents (e.g., historical radiological assessment), and supporting standard operating procedures
- Alpha, beta, and gamma emitting radionuclides
- A description of radiation exposure risks and monitoring requirements
- Access and egress protocol specific to the radiologically impacted location(s) requiring entry
- Radiation exposure reduction techniques for an embryo/fetus
- Completion of applicable briefing/exposure monitoring documentation
- Notification of contacts as needed to complete training requirements

Prior to entry to an impacted area, APTIM will ensure non-radiological remediation contractors entering the area have the required dosimetry (if necessary), have

completed the radiological awareness briefing, and have been briefed on the requirements established in the RWP in accordance with applicable standard operating procedures. Persons entering an impacted area will sign in and out on an access log and comply with requirements established in the RWP. In addition, personnel exiting an impacted area will be subject to a personnel survey by an RCT.

2.5.2 Incoming and Outgoing Surveys

Equipment and materials brought into radiologically impacted areas controlled by APTIM will be subject to an incoming survey by an RCT prior to entry into the controlled area. Surveys of incoming equipment will be performed in accordance with AMS-710-07-WI-04012, “Radiological Surveys and Monitoring,” and AMS-710-07-WI-40121, “Performing and Documenting Radiation and Contamination Surveys” (APTIM, 2022). During these survey activities, accessible surfaces will be surveyed for removable and fixed surface contamination and the results documented. An equipment tracking log will be maintained for equipment entering and exiting radiologically impacted areas.

2.5.3 Radioactive Check Sources

As part of the basewide radiological program, APTIM will provide and maintain exempt quantity radioactive check sources which will be used in source response testing of on-site radiological survey instruments and the portal monitor. APTIM will properly store and control the radioactive check sources per applicable state and federal radiation licenses.

2.5.4 Personnel Dosimetry

As part of the radiological health and safety program, occupational whole-body radiation exposures will be monitored, tracked, and recorded. APTIM will provide non-radiological remediation contractors working in impacted areas with personal dosimetry. In addition, basewide support personnel entering or surveying impacted areas will wear personal dosimetry. Visitors entering impacted areas under RCT escort do not require dosimetry as long as they do not perform or supervise hands-on work. Examples include site walks, surveying, utility marking, and other short-term periodic visits.

Only National Voluntary Laboratory Accreditation Program-approved dosimeters from a National Voluntary Laboratory Accreditation Program-certified provider will be used. Records will be maintained according to APTIM recordkeeping procedures. Dosimeters

will be read on a monthly or quarterly basis, depending on the exposure risk and/or duration of the contractor's work activity. Dosimeter results will be provided to the contractor health and safety representative.

2.6 Waste Disposal

APTIM will radiologically sample and survey materials generated by non-radiologically licensed contractors as requested by the Navy. The materials may consist of wastewater, asphalt debris from durable cover repairs, soil from installation of groundwater monitoring wells, or materials not previously disposed of by other Navy contractors. In some cases, chemical sampling for disposal may also be required per the waste management plan (Appendix A). Radiologically contaminated materials will immediately be coordinated for offsite disposal as low-level radioactive waste (LLRW) with the LLRW waste broker for HPNS. Non-radiologically contaminated materials or non-LLRW will be disposed of properly after Navy review of the results.

Soil will be radiologically processed on RSY pads in accordance with the sampling and analysis plan (Appendix B) and Work Instruction D0006-4550-013, "RSY Pad Construction and Soil Processing" (Appendix D). Existing RSY pads will be used for this project and construction of new RSY pads is not expected. Prior to using existing RSY pads, the pad will be radiologically scanned to confirm radioactivity. This scan may be the post-use gamma scan from the previous usage if determined to be appropriate by the Project Radiation Safety Officer. Asphalt and/or debris will be radiologically processed in accordance with Work Instruction D0006-4550-010, "Radiological Survey of Oversized Debris" (Appendix D).

2.7 Work Instructions

APTIM will develop work instructions, on an as-needed basis, for task-specific activities that require radiological oversight. Work instructions will be reviewed and approved by the Navy prior to finalization. Work instructions developed for the basewide radiological support program will be inserted into Appendix D of this work plan and maintained on site. Work instructions that are no longer applicable will be removed from Appendix D of this work plan.

3.0 Basewide Environmental Protection Coordination and Support

APTIM will provide oversight of environmental protection activities, including observation of construction practices, environmental controls such as dust management and stormwater protection, and monitoring of impact to the durable cover and other remedies maintained by the Navy on the parcels.

3.1 Basewide Meteorological Station

APTIM will install and operate an onsite meteorological station to support remediation activities at HPNS. The meteorological station will include the following:

- 10-meter tilt over tower
- Required signal cables and mounting components/hardware
- Data logger with built-in cellular modem in weatherproof enclosure
- Data logging software with web-based capabilities (LoggerNet or equivalent)
- Solar panel powered system (if necessary)
- Meteorological sensors and equipment to measure:
  - Wind speed
  - Wind direction
  - Ambient temperature
  - Relative humidity
  - Precipitation
  - Solar radiation

3.1.1 Meteorological Station Siting

The meteorological station is sited using guidelines presented in the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume IV: Meteorological Measurements, Version 2.0 (Final) (U.S. Environmental Protection Agency [EPA], 2008) to the extent practical. The siting location is shown on Figure 3 and was selected to be representative of meteorological conditions for the entire base and beyond the influence

of obstructions to the extent practicable. Table 1 summarizes EPA guidelines for siting and exposure for meteorological sensors.

The meteorological station siting is limited by location in relation to an electrical power source, a central location for projects on site, and selected to avoid potential location impacts on current and future Navy projects. As shown in Figure 3, the open terrain behind the Navy contractor trailers in Parcel C was selected as the station siting due to its proximity to potential obstructions and away from current and ongoing field activities. The closest obstruction to the station siting is a trailer that is approximately 4 meters tall and approximately 12 meters from the location. The next closest obstruction is Building 135 and is approximately 6 meters tall and 41 meters from the location. Lastly, the location is about 120 meters away from Building 214, which is approximately 8 meters tall.

The meteorological station siting is on top of asphalt as the appropriate locations on site that meet EPA criteria are predominantly paved. To prevent interferences with the temperature and precipitation sensors, the sensors are placed at the 9-meter level instead of the typical 2-meter level.

3.1.2 Operation and Maintenance

The meteorological station will be inspected daily (workdays) to check the power source and connection, cellular connection and data logging are functional, and that components and sensors are functioning as expected. Table 2 summarizes measurement quality objectives. The components and sensors will be inspected and National Institute of Standards and Technology-certified calibrated annually (Section 3.1.3).

3.1.3 Field Quality Control Procedures and Calibration Audits

A QC Program will be implemented to ensure that collected data are accurate and precise to effectively characterize both the magnitude and variations in ambient conditions at HPNS. Complete documentation of the results of routine operations and QC aspects of the program, including log notes, calibration forms, and certifications, will be maintained on file. The sensors will be audited annually by a third party and fulfill state and local air monitoring stations criterion as outlined in the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume IV: Meteorological Measurements, Version 2.0 (Final) (EPA, 2008). Because the meteorological data will

not be used as inputs for complex air modeling, the state and local air monitoring stations calibration standards are appropriate for this meteorological station (Table 3).

3.1.4 Data Collection and Reporting

The meteorological sensor data will be collected digitally using data logging support software (such as LoggerNet or equivalent). Data will be downloaded to the data logging software by cellular connection. The data logging platform is also web-based so that data can be accessed remotely.

APTIM will be prepare deliverables such as creating basewide monitoring network maps and figures, review and consolidate multiple contractor's air and dust monitoring reports for basewide reporting and perform field visits to ensure adequate environmental protection is in place, and in accordance with contractors' work plans.

3.2 Stockpile Tracking

APTIM will maintain a basewide tracking table of waste piles within the radiologically controlled areas and impacted areas at HPNS. The current version of the table (as of January 1, 2021) is provided as Appendix C. Information from other contractors performing radiological work at HPNS will be consolidated and updated on a regular basis. The radiological status of the waste piles will be verified at a minimum of every two weeks.

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4.0 Contractor Quality Control Plan

This Contractor Quality Control (CQC) Plan describes the QC actions and procedures that will be followed during execution of work under this CTO. This CQC Plan will be used in conjunction with the following:

- *Final Corporate Quality Management Plan, Contract N62473-17-D-0006, Environmental Multiple Award Contract for Remediation of Radiological Contaminants (RADMAC II)* (CB&I Federal Services LLC, 2017), which includes quality control directives (QCDs)
- AMS (APTIM, 2022)

A Project QC Manager will be present at the work site to implement and manage the QC Program. The Project QC Manager will work closely with the Project Manager (PM) and with the Navy quality assurance representatives to assure that the work is performed in compliance with specifications contained in the approved work plan, O&M Plans, and this CQC Plan. The Project QC Manager has the authority to stop work if contract requirements are not being met. In the event that the Project QC Manager is unavailable, an alternate QC Manager will assume this responsibility.

The Program QC Manager for this Navy contract is responsible for developing, maintaining, and enforcing the QC Program for the contract, and will work directly with the PM and the Project QC Manager to assure that work is performed in compliance with the contract. The Program QC Manager will serve as an alternate contact for the Project QC Manager if questions arise regarding acceptability of materials or performance during the project.

The PM reports to the Program Manager for the contract, who has the responsibility and authority to ensure that the work is performed according to the approved specifications and to the Navy's satisfaction.

Figure 2 depicts APTIM's project organization for this CTO. Tables 4 through 7 are documents from the QCDs tailored to this CTO, which will help achieve statement CTO objectives. If additional project-specific quality procedures are required as the project progresses, these procedures will be inserted into as an appendix.

4.1 Quality Control Organization

APTIM structured its corporate QC organization to support the Program Managers and PMs who have ultimate responsibility for the quality of services APTIM provides. The Program Managers and PMs are responsible for ensuring that personnel in their organizations understand the corporate and contract-specific QC programs and that their organizations' functions are set up and maintained effectively.

Quality issues are resolved at the lowest possible organizational level at each project site, to enable timely correction action development and implementation. Issues that cannot be satisfactorily resolved at the project level are elevated to and resolved at the corporate level.

APTIM's project organization chart, including QC personnel, is shown on Figure 2. The figure illustrates the reporting and communication relationships between QC personnel, the APTIM field team, subcontractors, and Navy representatives. This structure provides the organizational freedom for personnel to identify and evaluate quality problems and discrepancies, provide recommended solutions, and ensure that appropriate corrective actions are taken.

The specific responsibilities and qualifications associated with each QC-related position are outlined in Table 4.

4.1.1 Quality Control Personnel and Qualifications

Key QC personnel for APTIM projects are assigned on the basis of appropriate experience and the determination that these individuals meet the contract and CTO-specific requirements. The Project QC Manager and Alternate Project QC Manager are appointed by the Program QC Manager. The following paragraphs identify the QC team for this CTO and highlight their responsibilities. Copies of appointees' letters of designation are included in Appendix E.

4.1.1.1 Project Quality Control Manager

The Project QC Manager, who reports directly to the Program QC Manager, will work closely with the PM, Radiation Safety Officer, Radiation Control Supervisor, and Navy QC representatives to assure that the work is performed in compliance with the specifications contained in the approved work plan. The Project QC Manager has the authority to stop work if contract requirements are not being met. The Project QC

Manager's responsibilities are listed in Table 4. In the event the Project QC Manager is unavailable, an Alternate Project QC Manager will assume this responsibility.

4.1.1.2 Alternate Project Quality Control Manager

In the event the Project QC Manager is unavailable, an Alternate Project QC Manager will assume the QC responsibilities outlined in Table 4 and described in this CQC Plan. The Alternate Project QC Managers designated for this project are identified in Appendix E.

The project team, including subcontractors, will use procedures in this subsection to ensure quality and achieve project objectives.

4.1.2 Quality Control Directives

The following QCDs apply to this CTO:

- QCD 1.0, "Project Quality Control Personnel Duties, Qualifications, and Authority"
- QCD 2.0, "Project Quality Control Plans"
- QCD 3.0, "Design Review"
- QCD 4.0, "Coordination and Mutual Understanding Meeting"
- QCD 5.0, "Project Quality Control Meetings"
- QCD 6.0, "Submittals"
- QCD 7.0, "Documentation"
- QCD 8.0, "Quality Control Certifications"
- QCD 9.0, "Three Phases of Control"
- QCD 10.0, "Completion Inspections"
- QCD 11.0, "Testing"
- QCD 12.0, "Corrective Action Requests and Non-compliance"
- QCD 13.0, "Rework"
- QCD 14.0, "Change Control"
- QCD 15.0, "Organization and Personnel Certifications Log"
- QCD 16.0, "Field Startup"

- QCD 17.0, “PM Turnover”
- QCD 18.0, “Training”
- QCD 19.0 “Quality Audits”
- QCD 20.0 “Quality Control for Geophysical Surveys”

4.1.3 APTIM Quality Procedures

The following documents describe the administrative and technical requirements for uniform quality performance for this project. These procedures are developed, maintained, and hosted corporately within the AMS. Procedures can be accessed by APTIM employees and will be provided to the government upon request (APTIM, 2022).

- AMS-720-01-PR-00130, “Quality Management Organization” (supersedes EIP-Q-001, “Quality Organization”)
- EIP-Q-002, “Stop Work Notice for Quality Related Issues” (no current AMS equivalent)
- AMS-720-01-PR-00120, “Project Quality Plans” (supersedes EIG-Q-003, “Project Quality Plan”)
- AMS-720-02-PR-00480, “Receiving Inspection” (supersedes EIP-Q-004, “Receipt Inspection”)
- AMS-720-01-PR-00230, “Construction Inspection Program” (supersedes EIP-Q-005, “Inspection”)
- AMS-720-01-PR-00290, “Inspection and Test Plans” (supersedes EIP-Q-005, “Inspection” and EIP-Q-016, “Test Control”)
- AMS-720-01-GL-00230, “Guidelines for Quality Surveillance Activities” (supersedes EIP-Q-006, “Surveillance”)
- AMS-720-01-PR-00150, “Identification, Control, and Disposition of Nonconforming Product” (supersedes EIG-Q-007, “Nonconformance Reporting”)
- AMS-720-01-PR-00170, “Corrective and Preventive Action” (supersedes EIG-Q-008, “Corrective Action”)
- AMS-720-01-PR-00220, “Management System Audits” (supersedes EIG-Q-009, “Quality Audits”)

- AMS-720-01-GL-00223, “Qualification and Assessment of Internal Audit Personnel” (supersedes EIP-Q-010, “Auditor and Lead Auditor Qualification Program”)
- EIP-Q-014, “Management Assessment” (no current AMS equivalent)
- EIG-Q-015, “Quality Councils” (no current AMS equivalent)

Note: The QCDs take precedence over these procedures

4.2 Outside Organizations

To manage subcontractors and vendors effectively, APTIM carefully selects and prequalifies each firm. APTIM continuously and aggressively manages subcontractor costs, schedule, safety, and quality performance. The pre-qualification process ensures that subcontractors bring the same focus on quality, cost control, schedule discipline, and commitment to customer satisfaction as APTIM. Once an award is made to a subcontractor, APTIM manages the quality of the subcontractor’s performance through the three-phase inspection process outlined in Section 4.8.

Laboratories providing environmental analyses are accredited as noted in Section 5.11 of the base contract (N62473-17-D-0006).

Names and qualifications of subcontractors proposed for this project are summarized in Table 5. Subcontractors will be subject to APTIM QC procedures. Testing and inspection procedures will be monitored by APTIM as described in Section 4.4.

4.3 Submittal Procedures

Submittals will be managed by APTIM as required by contract. The Project QC Manager will review and approve items prior to submittal. The Project QC Manager will certify that submittals are in compliance with contract requirements. Radiological data will be reviewed by the Project Radiation Safety Officer or designee prior to submittal. Submittals are further discussed under QCD 6.0.

4.4 Testing

In addition to implementing the three phases of the control system to ensure the overall quality of each definable feature of work (DFOW), APTIM will make use of formal testing procedures where applicable, including tests performed by subcontractors and/or off-site laboratories, to ensure conformance to applicable specifications and verify that

control measures are adequate to provide a finished product which conforms to contract requirements. The Project QC Manager will ensure that sampling and testing are managed and performed as required by contract.

4.4.1 Testing Plan and Log

If necessary, the Project QC Manager will use the Testing Plan and Log, contained in Table 7, to manage project testing. As tests are performed, the Project QC Manager will record on the log the date the test was performed and the date the test results were forwarded to the Contracting Officer (KO) or Contracting Officer Representative (COR) as applicable. The Project QC Manager will attach a copy of the updated log to the last Daily Contractor QC Report of each month. Chemical or radiological sampling and analyses are normally not included in the log, since requirements are implemented by the Abbreviated Sampling and Analysis Plan (Appendix B).

4.4.2 Testing and Documentation

APTIM will submit test reports, containing test results to the KO and/or COR as required by contract. Test reports will cite applicable contract requirements, tests or analytical procedures used, and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, APTIM will notify the KO and/or COR immediately. APTIM will submit the signed test reports, certifications, and other documentation to the KO and/or COR via the Project QC Manager. The Project QC Manager will submit a summary report of field tests in the Daily Contractor QC Report. Testing is further discussed under QCD 11.0.

4.5 Rework Items, Non-Compliances, and Corrective Action Requests

The Project QC Manager will review instances where materials, equipment, or activities fail to meet the specified requirements, and will take appropriate action to prevent future occurrences.

4.5.1 Rework

A rework item is work that does not comply with the contract. There is no requirement to report a rework item that is corrected the same day it is discovered. APTIM and subcontractor personnel will be responsible for identifying rework items and reporting them to the Project QC Manager. The Project QC Manager will coordinate with the

Project Superintendent to ensure rework items are corrected in a timely manner. The Project QC Manager will maintain a Rework Items List of work that does not comply with the contract, including those identified by the KO or his/her representative. The Project QC Manager will report identified and corrected items in the Daily Contractor QC Report and during Project QC Meetings and will attach a copy of the Rework Items List to the last Daily Contractor QC Report of each month. Rework items are further discussed under QCD 13.0.

4.5.2 Non-Compliances

The KO may also notify APTIM of detected non-compliance with the contract. APTIM will take immediate corrective action after receipt of such notice. Such notice, when delivered to APTIM at the work site, will be deemed sufficient for the purpose of notification. Non-compliances are further discussed under QCD 12.0.

4.5.3 Corrective Action Requests

APTIM will identify, track, and correct items, processes, and services that do not meet established requirements. Correction will focus on determining the cause of the deficiency and corrective actions will address the deficiency and prevent recurrence. Corrective Action Requests are further discussed under QCD 12.0.

4.5.4 Procedures for Tracking Laboratory Deficiencies

Laboratory testing requirements for radiological analyses and procedures for identifying and managing deficiencies are addressed under the Abbreviated Sampling and Analysis Plan (Appendix B).

4.6 Documentation

A variety of documents will be developed at specified points or intervals during the course of this project to support the QC process. These items will be submitted to the government or maintained by APTIM and made available for review as required. QC-related project documentation may include:

- Testing plan and log
- Daily CQC reports
- Three-phase control inspection checklists (preparatory, initial, and follow-up)

- QC meeting minutes
- Rework items list
- Non-compliance/corrective action reports
- As-built drawings
- Material receipt inspections

Documentation is further discussed under QCD 7.0.

4.6.1 Daily Reports

APTIM will submit reports for each day that work is performed as required by contract. Reports will be attached to the Daily Contractor QC Report. Reports may also be submitted on a weekly basis depending on the nature of work and with approval from the Navy. The reporting of work will be identified by terminology consistent with the construction schedule. The “remarks” section of reports will include directions received, construction deficiencies and problems, QC problems, deviations from project plans, conflicts or errors in the drawings or specifications, field changes, instructions given and corrective actions taken, work progress and delays, safety hazards, meetings held, and visitors to the work site.

4.6.1.1 Daily Contractor Quality Control Report

The Project QC Manager is responsible for preparing and signing the Daily Contractor QC Report. Other QC, production, and health and safety documents may be attached to this report. The Project QC Manager will submit the report to the Navy by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.

4.6.1.2 Daily Contractor Production Report

The Project Superintendent or designee is responsible for preparing and signing the Daily Contractor Production Report. The report will be attached to the Daily Contractor QC Report.

4.6.1.3 Quality Control Specialist Report

If a QC Specialist is assigned, he/she will prepare, sign, and date a report for each day that work is performed in his/her area of responsibility. This report will include the same documentation requirements as are submitted with the Daily Contractor QC Report.

4.6.2 Quality Control Meeting Minutes

After the start of construction, the Project QC Manager will commence holding weekly QC meetings with the Site Superintendent, QC staff, and Site Safety and Health Officer. The Navy Remedial Project Manager/COR, Caretaker Site Office, Resident Officer in Charge of Construction, and RASO may also attend these meetings as required.

As a minimum, the following will be accomplished at each QC meeting as needed:

- Review the minutes of the previous meeting
- Review the status of work, inspections, testing, rework, and submittals
- Review the work, inspections, and testing to be accomplished in the next two weeks and documentation required
- Resolve QC, production, and safety concerns
- Address items that may require revising the project plans
- Review the accident prevention plan and/or activity hazard analyses as necessary
- Review environmental requirements and procedures as necessary
- Review the following, as applicable
  - Waste Management Plan
  - Radiological Protection Plan
  - Status of training completion and progress

The Project QC Manager will prepare the minutes of the meetings and provide a copy to the COR within two working days after the meeting.

4.6.3 Quality Control Validation

APTIM will maintain files of original documents in a home office, including project documents. Copies of project documents will also be filed in the field office. Project files

include, but are not limited to, inspection reports and checklists, Testing Plan and Log, Rework Items List, and punch lists. Reports are required from the QC Specialists (if assigned) for each day that work is performed in their area of responsibility. QC Specialist reports will include the same documentation requirements as the Daily Contractor QC Report for their area of responsibility. QC Specialist reports are to be prepared, signed, and dated by the QC Specialists and will be attached to the Daily Contractor QC Report prepared for the same day.

4.6.4 As-Built Drawings

The Project QC Manager will ensure the as-built drawings are kept current on a daily basis and marked to show deviations from the contract drawings identified with the appropriate modifying documentation. The Project QC Manager or QC Specialist assigned to that area of responsibility will initial each revision. Upon completion of work, the Project QC Manager will certify the drawings, attesting to their accuracy, and ensure that they are submitted to the CO per QCD 8.0.

4.7 Definable Features of Work

A DFOW is a representative portion of work that is separate and distinct from other stage of work. The following DFOWs have been identified for this project (Table 8):

- DFOW 1: Radiological Controls and Postings, and Routine Surveys
- DFOW 2: Radiological Sample Inventory and Sample Archive Maintenance
- DFOW 3: Portal Monitor and Truck Wash
- DFOW 4: Radiological Support to Other Contractors
- DFOW 5: Waste Disposal
- DFOW 6: Basewide Environmental Protection Coordination and Support
- DFOW 7: Basewide Operation and Maintenance of Durable Cover

Basewide O&M will be performed in accordance with the parcel-specific O&M plans and the *Fencing and Security Plan, Basewide Operation, Maintenance and Radiological Support at Former Hunters Point Naval Shipyard, San Francisco, California* (APTIM, 2021c).

4.8 Three Phases of Control

The Project QC Manager manages the three phases of control to adequately cover on-site and off-site DFOWs. The Project QC Manager may assign the Task Leader for DFOWs to other project personnel, including the Project Engineer, Project Geologist, Project Superintendent, QC Specialist, etc.

4.8.1 Preparatory Phase

The Project QC Manager will notify the CO and/or COR, as applicable at least two workdays, two weeks for off-site work, in advance of each preparatory phase meeting. The assigned lead shown on the project DFOW matrix will conduct the meeting. At a minimum, the Project QC Manager, QC staff, Project Superintendent, foreman, and Site Safety and Health Officer will attend. When a subcontractor will perform work, that subcontractor's superintendent will attend.

4.8.1.1 Preparatory Phase Activities

The following will occur during the preparatory phase:

- Review each paragraph of the applicable specification sections.
- Review the contract drawings.
- Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.
- Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.
- Review the Testing Plan and Log, and ensure that provisions have been made to provide the required QC testing.
- Examine the work area to ensure that the required preliminary work has been completed.
- Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- Examine the required materials, equipment, and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data.

- Discuss construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems.
- Review the APP/SSHP (APTIM; 2021b) and appropriate activity hazard analyses to ensure that applicable safety requirements are met and that required material safety data sheets are submitted.

Results of the preparatory phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report.

4.8.2 Initial Phase

The Project QC Manager will notify the KO and/or COR at least two workdays (two weeks for off-site work) in advance of each initial phase. The assigned lead shown on the project DFOW matrix will perform the initial phase and he/she will observe the initial segment of the DFOW to ensure that the work complies with contract requirements. Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report. The following will be performed:

- Establish the quality of workmanship required
- Resolve conflicts
- Ensure that testing is performed by the approved laboratory
- Check work procedures for compliance with the APP/SSHP (APTIM; 2021b) and the appropriate activity hazard analyses to ensure that applicable safety requirements are met

Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report.

4.8.3 Follow-up Phase

The assigned lead shown on the project DFOW matrix will perform the follow-up phase for ongoing work daily, or more frequently as necessary, until the completion of the work. Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report. The following will be performed:

- Ensure the work is in compliance with contract requirements
- Maintain the quality of workmanship required

- Ensure that testing is performed by the approved laboratory
- Ensure that rework items are being corrected
- Perform safety inspections

4.8.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases will be conducted for a deficiency if the quality of ongoing work remains or becomes unacceptable; there are changes in the applicable QC organization; there are changes in the on-site production supervision or work crew; work is resumed after substantial period of inactivity; or other problems develop. The three phases of control are further discussed under QCD 9.0.

4.9 Completion Inspections

Project inspections that demonstrate completeness are described in this subsection. Inspections may include a punch-out inspection, pre-final inspection, and final acceptance inspection.

4.9.1 Punch-Out Inspection

The Project QC Manager will manage completion inspections. Near the completion of work or to verify that statement of objectives or performance work statements are met, the Project QC Manager will ensure work is inspected and a punch list developed. Punch list items include items that do not conform to the approved drawings, specifications and contract, and remaining rework items. The punch list will indicate the estimated correction dates of these items. A copy of the punch list will be provided to the COR, if required by contract. The Project QC Manager will ensure corrected items are verified. Once this is accomplished, he/she will schedule a pre-final inspection.

4.9.2 Pre-Final Inspection

The Navy will perform a pre-final inspection to verify that fieldwork is complete. A Navy punch list may be developed as a result of this inspection. The Project QC Manager will ensure that the items on this list are corrected prior to notifying the Navy that a final inspection with the client can be scheduled. Items noted during the preliminary-final inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work.

4.9.3 Final Acceptance Inspection

If required by contract, the Project QC Manager will notify the KO and/or COR at least 14 calendar days prior to the date a final acceptance inspection can be held, stating that items previously identified during the pre-final will be corrected and acceptable, along with other unfinished contract work, by the date of the inspection. The Project QC Manager, Project Superintendent, and others deemed necessary will be present during the inspection with the Navy. If deficiencies remain or are identified during the inspection, the parties will agree on a course of action. Completion inspections are further discussed under QCD 10.0.

4.9.4 Inspection Documentation

Inspection records will be maintained by the Project QC Manager in accordance with QCD 7.0.

5.0 References

Aptim Federal Services, LLC (APTIM), 2021a, *Radiation Protection Plan, Basewide Operation, Maintenance and Radiological Support at Former Hunters Point Naval Shipyard, San Francisco, California*.

APTIM, 2021b, *Accident Prevention Plan, Basewide Operation, Maintenance and Radiological Support at Former Hunters Point Naval Shipyard, San Francisco, California*.

APTIM, 2021c, *Fencing and Security Plan, Basewide Operation, Maintenance and Radiological Support at Former Hunters Point Naval Shipyard, San Francisco, California*.

APTIM, 2022, *APTIM Management System*.

CB&I Federal Services LLC, 2017, *Final Corporate Quality Management Plan, Contract N62473-17-D-0006, Environmental Multiple Award Contract for Remediation of Radiological Contaminants (RADMAC II)*, May.

Code of Federal Regulations, Title 10, Section 19, *Notices, Instructions and Reports to Workers: Inspection and Investigations*, current version.

Code of Federal Regulations Title 10, Section 20, *Standards for Protection Against Radiation*, current version.

U.S. Environmental Protection Agency, 2008, *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume IV: Meteorological Measurements, Version 2.0 (Final), March.

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FIGURES

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*APTIM,

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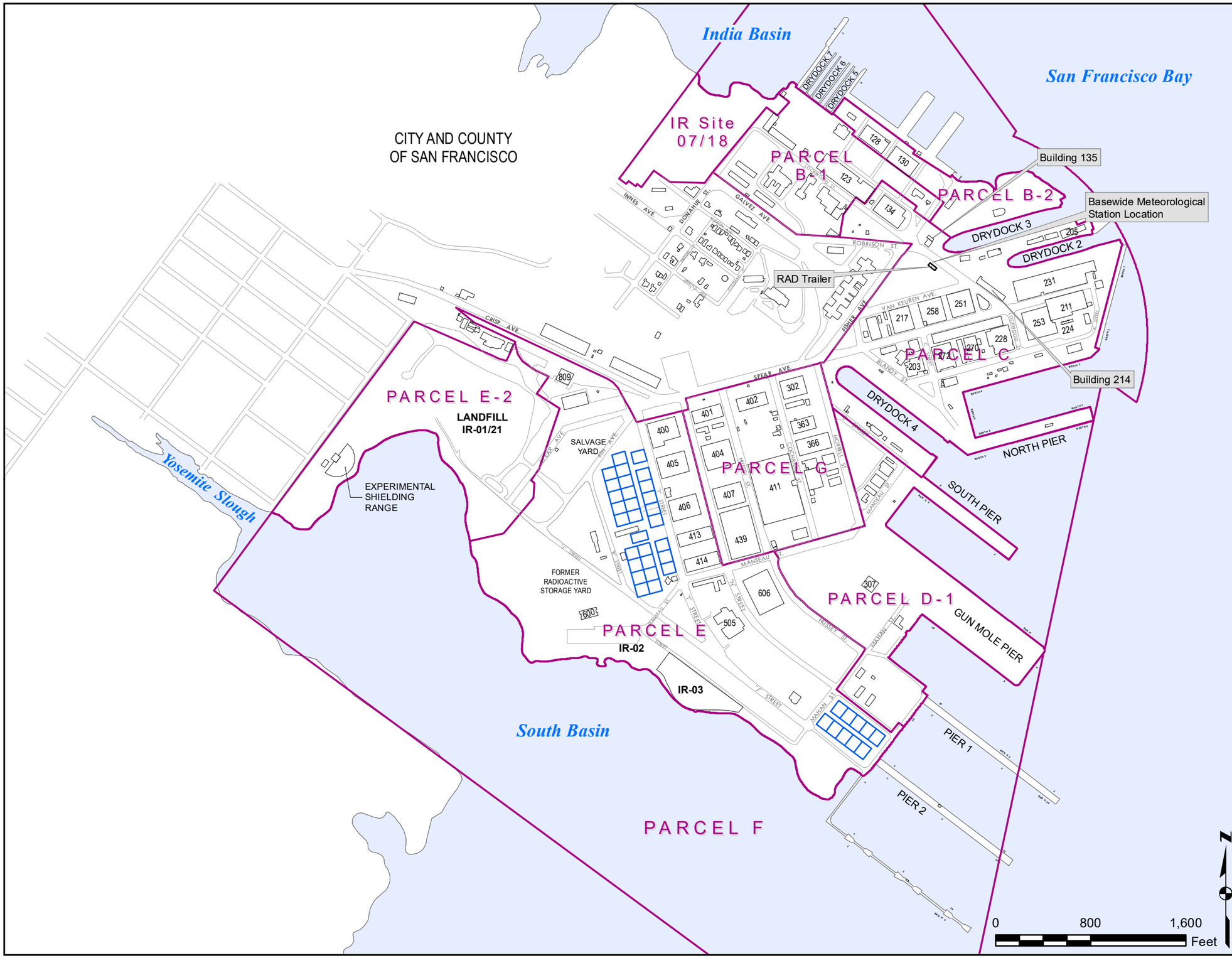

Legend

Parcel Boundary

VICINITY MAP

U.S. Department of the Navy
BRAC PMO West
San Diego, California

FIGURE 3
METEOROLOGICAL STATION SITING

BASEWIDE RADIOLOGICAL SUPPORT
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

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TABLES

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Table 1: Siting and Exposure for Meteorological Sensors

Measurement	Distance from Obstruction	Distance Above Ground	Recommended Ground Cover [a]	Comments
Ambient Temperature	1.5x the tower diameter	1.25 to 2 meters	Non-irrigated or un-watered short grass, or natural earth	The surface should not be concrete, asphalt, or oil soaked. Reflection from these surfaces may affect the performance of the sensor.
Wind Speed/Direction	10x the height of the obstruction	10 meters	Grass or gravel	The standard exposure of the wind instruments over level, open terrain is 10 meters above ground.
Solar Radiation	2 meters	2 to 10 meters	No requirements	Sensor should be free from obstructions above the plane of the sensor. It should be located so that shadows will not cast on the device.
Barometric pressure	1 meter	1 to 10 meters	No requirements	The location should have uniform, constant temperature, shielded from the sun, away from drafts or heaters.
Precipitation	2x to 4x the obstruction height	30 cm, minimum	Natural vegetation or gravel	Asphalt or concrete should be avoided to avoid splashing the gage. The gage should be high enough to avoid it being covered by snow.

Notes:

[a] The proposed siting is on top of asphalt as the most appropriate location meeting EPA criteria is paved. To prevent interferences with the temperature and precipitation sensors, the sensors will be placed at the 9-meter level instead of the typical 2-meter level.

Reference: U.S. Environmental Protection Agency, 2008, *Quality Assurance Handbook for Air Pollution Measurement Systems,* Volume IV: Meteorological Measurements, Version 2.0 (Final), Table 0.12. March.

Table 2: Meteorological Station Measurement Quality Objectives

Measurement	Method	Reporting Units	Operating Range	Resolution	Minimum Sample Frequency	Raw Data Collection Frequency	Completeness
Ambient Temperature	Thermistor	ºC	-30-50	0.5	Hourly	1 minute	75%
Relative Humidity	Psychrometer/ Hygrometer	%	0-100	1.0	Hourly	1 minute	75%
Wind Speed	Cup, prop or sonic anemometer	m/s	0.5-50.0	0.2	Hourly	1 minute	75%
Wind Direction	Vane or sonic anemometer	Degrees	0-360 (540)	1.0	Hourly	1 minute	75%

Notes:
Reference: U.S. Environmental Protection Agency, 2008, *Quality Assurance Handbook for Air Pollution Measurement Systems,* Volume IV: Meteorological Measurements, Version 2.0 (Final), Table 0-5. March.

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Table 3: Meteorological Station Verification/Calibration and Accuracy Criteria

Measurement	Verification/Calibration			Accuracy		
	Type	Acceptance Criteria	Frequency	Type	Acceptance Criteria	Frequency
Ambient Temperature	3 pt. Water Bath with NIST-traceable thermistor or thermometer	±1.0 ºC	Annually	3 pt. Water Bath With NIST-traceable thermistor or thermometer	±1.0 ºC	Annually
Relative Humidity	NIST-traceable Psychrometer or standards solution	±10% RH	Annually	NIST-traceable Psychrometer or standards solution	±10% RH	Annually
Wind Speed	NIST-traceable Synchronous Motor, CTS Method	±0.25m/s ≤5m/s; 5%>2m/s not to exceed 2.5m/s	Annually	NIST-traceable Synchronous Motor	0.25m/s ≤5m/s; 5%>2m/s not to exceed 2.5m/s	Annually
Wind Direction	Solar Noon, GPS Magnetic Compass, CTS Method	±5 degrees; includes orientation error	Annually	Solar Noon, GPS or Magnetic Compass	±5 degrees; includes orientation error	Annually

Notes:
NIST National Institute of Standards and Technology

Reference: U.S. Environmental Protection Agency, 2008, *Quality Assurance Handbook for Air Pollution Measurement Systems,* Volume IV: Meteorological Measurements, Version 2.0 (Final), Table 0-6. March.

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Table 4: Project Quality Control Duties and Responsibilities

Duty	Responsibility	QCD
Pre-Construction Phase		
Establish Personnel Requirements	PM	1.0
Review Personnel Resumes	PM	1.0
Assign Duties	PM	1.0, 2.0
Prepare Organization Chart	PQCM	1.0, 2.0
Prepare Letters of Designation	PQCM	1.0, 2.0
Review Plans and Designs	PM, PQCM	3.0, 7.0
Identify Subcontractors	PM	1.0, 2.0
Submit Laboratory Information	PQCM	1.0, 2.0
Attend Training	all	1.0
Prepare Submittal Register	PQCM	2.0, 6.0
Prepare Definable Features of Work Matrix	PQCM	2.0, 9.0
Prepare Testing Plan and Log	PQCM	2.0, 11.0
Prepare Rework Items List	PQCM	2.0, 13.0
Assemble Forms	PQCM	2.0
Assemble Personnel Certifications	PQCM	8.0, 15.0
Conduct Coordination and Mutual Understanding Meeting	PQCM	4.0
Construction Phase		
Ensure Construction Quality	PM	1.0, 14.0, 16.0, 17.0
Review Definable Features of Work	PQCM	9.0
Ensure Submittals Approved and Submitted	PQCM	3.0, 6.0, 7.0
Conduct Project QC Meetings	PQCM	5.0
Conduct Preparatory Meetings	PQCM	9.0
Conduct Preparatory Inspections	PQCM	9.0
Conduct Initial Inspections	PQCM	9.0
Conduct Follow-Up Inspections	PQCM	9.0
Conduct Completion Inspections	PQCM	10.0
Manage Corrective Action Requests	PQCM	12.0
Manage Rework Items	PQCM	13.0
Provide QC Certifications	PQCM	8.0

Notes:
The PQCM may assign the lead for inspections to the other project personnel: Task Lead, Project Site Superintendent, etc.

PM project manager
PQCM project quality control manager
QC quality control
QCD quality control directive

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Table 5: Outside Organizations

Organization Name/Address/Phone	Description of Services
	Environmental Analytical Services
	Utility Location
	Meteorological Station
	Site Security
	Rock/Import Material
	Equipment Rental Services

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Table 6: Submittal Register

Submittal Register																										
Contract Number: N62473-17-D-0006 Task Order: N6247321F5082																										
Title and Location: Basewide Operation, Maintenance and Radiological Support, Hunters Point Naval Shipyard, San Francisco, California															Contractor: Aptim Federal Services, LLC						Specification Section Scope of Work				
				Type of Submittal									Classification			Contractor Schedule Dates			Contractor Action			Government Action				
Transmittal No.	Item No.	Specification Paragraph No.	Description of Item Submitted	Data	Drawings	Instructions	Schedules	Statements	Reports	Certificates	Samples	Records	Information Only	Government Approved	Reviewer	Submit	Approval needed by	Material needed by	Code	Date	Submit to government	Code	Date			Remarks
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X			Y
	001	Section 2.1.1	Copy of NRC and CA License and SOPs					X		X			X													
	002	Section 2.2.1	Kickoff Meeting Minutes					X						X	RPM											Within 10 days of meeting
	004	Section 2.2.1.1	Internal Draft Work Plan Documents		X		X	X						X	RPM											60 days after task order award
	005	Section 2.2.1.1	Responses to Navy Comments		X		X	X							RPM											Due to Navy 14 days after receipt of comments
	008	Section 2.2.1.1	Final Work Plan Documents		X		X	X						X	RPM											10 days after Navy concurrence of RTCs
	009	Section 2.2.2	Internal Draft APP/SSHP		X			X						X	Navy NMCPHC											60 days after task order award
	010	Section 2.2.2	Responses to Navy Comments		X			X						X	Navy NMCPHC											Due to Navy 14 days after receipt of comments
	011	Section 2.2.2	Final APP/SSHP		X			X						X	Navy NMCPHC											10 days after Navy concurrence of RTCs
	012	Section 2.2.3	Internal Draft Radiological Protection Plan		X			X						X	Navy											60 days after task order award
	013	Section 2.2.3	Responses to Navy Comments		X			X						X	Navy											Due to Navy 14 days after receipt of comments
	014	Section 2.2.3	Final Radiological Protection Plan		X			X						X	Navy											10 days after Navy concurrence of RTCs

Submittal Register																										
Title and Location: Basewide Operation, Maintenance and Radiological Support, Hunters Point Naval Shipyard, San Francisco, California																Contract Number: N62473-17-D-0006 Task Order: N6247321F5082 Contractor: Aptim Federal Services, LLC						Specification Section Scope of Work		
				Type of Submittal									Classification			Contractor Schedule Dates			Contractor Action			Government Action		
Transmittal No.	Item No.	Specification Paragraph No.	Description of Item Submitted	Data	Drawings	Instructions	Schedules	Statements	Reports	Certificates	Samples	Records	Information Only	Government Approved	Reviewer	Submit	Approval needed by	Material needed by	Code	Date	Submit to government	Code	Date	Remarks
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
	015	Section 2.3.1.2.1	Internal Draft Fencing and Security Plan		X			X						X	Navy									60 days after task order award
	016	Section 2.3.1.2.1	Responses to Navy Comments		X			X						X	Navy									Due to Navy 14 days after receipt of comments
	017	Section 2.3.1.2.1	Final Fencing and Security Plan		X			X						X	Navy									10 days after Navy concurrence of RTCs
	018	Section 2.3.3.2	Routine Survey Reports					X							Navy									At least monthly, or as requested by the Navy
	019	Section 2.3.3.3	RCA Stockpile Tracking Table					X						X	Navy									Upon change in waste pile status, or as requested by the Navy
	020	Section 2.3.3.4	Portal Monitor Reports		X			X	X			X			Navy									By the 5th of the month
	021	Section 2.3.3.5.2	Equipment Tracking Log					X							Navy									By the 5th of the month
	022	Section 2.4.1	Internal Draft Basewide Operation and Maintenance Report	X	X			X	X			X		X	RPM									February 1
	023	Section 2.4.1	Responses to Navy Comments	X	X			X	X			X		X	RPM									Due to Navy 14 days after receipt of comments
	024	Section 2.4.1	Final Basewide Operation and Maintenance Report	X	X			X	X			X		X	RPM									10 days after Navy concurrence of RTCs

Notes:

APP/SSHP	Accident Prevention Plan/Site Safety and Health Plan
CA	California
Navy	U.S. Department of the Navy
NMCPHC	Navy and Marine Corps Public Health Center
NRC	U.S. Nuclear Regulatory Commission
RCA	radiologically controlled area
RPM	Remedial Project Manager
RTC	Response to Comments

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Table 7: Testing Plan and Log

Contract No. N62473-17-D-0006 Contract Task Order N6247321F5082			Hunters Point Naval Shipyard San Francisco, California							Contractor APTIM	
Specification Section and Paragraph Number	Test Procedure [a]	Test Name	Accredited/ Approved Laboratory		Sampled by	Location of Test On Site or Off Site		Frequency of Test	Date Completed	Date Forwarded to Contracting Officer	Remarks
			Yes	No							
31 00 00	California Test 301	R Value					X	1/source			Fill under asphalt
31 00 00	ASTM D 6913	Particle Size Distribution					X	1/2000 cy			Fill
31 00 00	ASTM D 4318	Atterberg Limits					X	1/2000 cy			Fill
31 00 00	ASTM D 698	Compaction					X	1/5,200 cy			Fill
31 00 00	ASTM 2487	Classification					X	1/2000 cy			Fill
31 00 00	ASTM D 2216	Moisture				X		1/2000 cy			Fill
31 00 00	ASTM D 6938	Density and Moisture				X		1/10,000 sf/lift			Fill/ subgrade
31 00 00	ASTM D 1556	Density, Sand Cone				X		1/150,000 sf/lift			Fill/ subgrade
31 00 00	Modified Proctor ASTM D 1557	Compaction Curves					X	1/5000 cy or change in material			Fill

Contract No. N62473-17-D-0006 Contract Task Order N6247321F5082			Hunters Point Naval Shipyard San Francisco, California							Contractor APTIM	
Specification Section and Paragraph Number	Test Procedure [a]	Test Name	Accredited/ Approved Laboratory		Sampled by	Location of Test On Site or Off Site		Frequency of Test	Date Completed	Date Forwarded to Contracting Officer	Remarks
			Yes	No							
32 10 00	ASTM D 1272	Extraction				X		2/day/mix (when at least 20 tons is placed)			Bituminous mix
32 10 00	AASHTO T30	SieveF				X		2/day/mix (when at least 20 tons is placed)			Bituminous mix
32 10 00	ASTM D 1559	Stability and Flow				X		2/day/mix (when at least 20 tons is placed)			Bituminous mix
32 10 00	AASHTO T 230	Density					X	3 cores/200 tons			Pavement

Notes:

Analytical testing requirements are provided in the Abbreviated Sampling and Analysis Plan (Appendix B).

[a]	Reference to testing procedures will be the current version.
AASHTO	American Association of State and Highway Transportation Officials
AB	aggregate base
APTIM	Aptim Federal Services, LLC
ASTM	ASTM International
cy	cubic yard per day
sf	square foot

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Table 8: Definable Features of Work Matrix

Plan/ Specification Section	Schedule Cross Reference	Feature of Work	Task Lead	Preparatory	Initial	Follow-Up	Completion
Work Plan/2.2	W.E. 3	Radiological Controls and Postings, and Routine Surveys					
Work Plan/2.3	W.E. 3	Radiological Sample Inventory and Sample Archive Maintenance					
Work Plan/2.4	W.E. 3	Portal Monitor Operation and Truck Wash					
Work Plan/2.5	W.E. 3	Radiological Support to Other Contractors					
Work Plan/2.6	W.E. 3	Waste Disposal					
Work Plan/3.0	W.E. 3	Basewide Environmental Protection Coordination and Support					
Parcel-specific O&M Plans, Fencing and Security Plan	W.E. 3	Basewide Operation and Maintenance					

Notes:

O&M	operation and maintenance
W.E.	work element

Table 9: Organization and Personnel Certifications Log

Definable Feature of Work	Certification Requirement	Code	Organization	Individual	Verified by/Date Verified	Certificate Expires
All Project Tasks	40-Hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response, including 8-Hour Refresher	P	APTIM	(all personnel)		
Lab Analysis	U.S. Department of Defense Environmental Laboratory Accreditation Program	S				

Legend:
Column 1, Definable Feature of Work: Refer to Construction Quality Control Plan table for list of definable features of work. List in order.
Column 2, Certification Requirement: State the certification required for the subcontractor, supplier, and/or individual.
Column 3, Code: S = Certificate required for the firm, that is, subcontractor or supplier; P = certificate required for the person performing the work.
Column 4, Organization: Subcontractor or supplier organization name.
Column 5, Individual: Name of certified individual (note: if certification requirement only applies to the firm, note name of person who provided certificate).
Column 6, Verified By/Date Verified: APTIM individual who verified certificates for organization and/or individuals. Verification required no later than Preparatory Inspection.
Column 7, Certificate Expires: Note the certificate expiration date.

Notes:
This log will be included in the Construction Quality Control Plan with Columns 1, 2, and 3 filled in. Remaining columns will be completed when information becomes available.
APTIM Aptim Federal Services, LLC

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APPENDIX A
WASTE MANAGEMENT PLAN

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Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
San Diego, CA

Appendix A

Final, Waste Management Plan

Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

February 2022

Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
San Diego, CA

Appendix A
Final, Waste Management Plan
Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

February 2022

DCN: APTM-0006-5082-0010

Prepared for:

Department of the Navy
Naval Facilities Engineering Systems Command Southwest
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Contract Number: N62473-17-D-0006; Task Order: N6247321F5082

Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
San Diego, CA

Appendix A
Final, Waste Management Plan
Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

February 2022

February 10, 2022
Date

DCN: APTM-0006-5082-0010

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Table of Contents

Table of Contents A-7
List of Tables A-8
List of Attachments A-8
Acronyms and Abbreviations A-9
A.1 Introduction A-11
A.2 Waste Categories and Classification A-13
A.2.1 Solid Waste A-13
A.2.2 Liquid Waste A-14
A.3 Transportation and Disposal Activities A-15
A.3.1 Waste Accumulation and Storage A-15
A.3.1.1 Labeling and Posting of Containers Containing Radioactive Waste A-16
A.3.1.2 Waste Accumulation Areas for Radioactive Waste A-16
A.3.1.3 Waste Minimization A-17
A.3.1.4 Inspections A-18
A.3.2 Waste Sampling, Characterization, and Profiling A-18
A.3.3 Waste U.S. Environmental Protection Agency Characterization and U.S. Department of Transportation Classification A-20
A.3.4 Selection of Transportation and Disposal Subcontractors A-20
A.3.5 Waste Manifest Package Preparation A-20
A.3.6 Waste Shipment and Tracking A-21
A.3.7 Waste Transportation and Disposal A-21
A.4 Waste Characterization Sampling Collection Methods and Procedures A-23
A.4.1 Sampling Strategy and Analytical Methods A-23
A.4.2 Sampling Procedure A-24
A.4.2.1 Soil Sampling A-24
A.4.2.2 Wastewater Sampling A-26
A.4.3 Sample Custody and Documentation A-26
A.4.4 Sample Numbering and Labeling A-27
A.4.5 Sampling Containers, Preservatives, and Holding Times A-27
A.4.6 Quality Control A-30

Table of Contents (continued)

A.4.7 Sample Packaging and Shipment A-31
A.4.8 Quality Assurance A-32
A.4.9 Documentation A-32
A.5 References A-33

List of Tables

Table A-1: Synopsis of T&D Activities and Staff Responsibilities A-37
Table A-2: Waste Accumulation Methods and Times A-39
Table A-3: Waste Sample Types and Analyses A-41
Table A-4: Preliminary Characterization and Classification A-43
Table A-5: Typical Waste Manifest Packages for Potential Waste Disposal Facilities (Non-Radiological Waste) A-45

List of Attachments

Attachment A-1: Waste Inventory Log A-47
Attachment A-2: Waste Storage Area Inspection Checklist A-51

Acronyms and Abbreviations

APTIM ..... Aptim Federal Services, LLC
CCR ..... California Code of Regulations
CFR ..... Code of Federal Regulations
CoC ..... chain of custody
DOT ..... U.S. Department of Transportation
DTSC ..... California Department of Toxic Substances Control
EPA ..... U.S. Environmental Protection Agency
LLMW ..... low-level mixed waste
LLRW ..... low-level radiological waste
Navy ..... U.S. Department of the Navy
NRC ..... U.S. Nuclear Regulatory Commission
PCB ..... polychlorinated biphenyl
PPE ..... personal protective equipment
RCRA ..... Resource Conservation and Recovery Act
SAP ..... sampling and analysis plan
SFPUD ..... San Francisco Public Utilities Department
STLC ..... soluble threshold limit concentration
SVOC ..... semivolatile organic compound
T&D ..... transportation and disposal
TTLC ..... total threshold limit concentration
TPH ..... total petroleum hydrocarbons
TTLC ..... total threshold limit concentration
VOC ..... volatile organic compound
Work Plan ..... *Final Work Plan, Basewide Radiological Support, Hunters Point Naval Shipyard, San Francisco, California*

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A.1 Introduction

This waste management plan was prepared and will be implemented by Aptim Federal Services, LLC (APTIM), under Contract No. N62473-17-D-0006, Contract Task Order N6247321F5082.

This waste management plan describes the categories of waste and project management and engineering controls that APTIM will use to accumulate, categorize, transport, and dispose of waste generated at the site in a cost-effective, timely, and compliant manner. Section 2.0 includes a summary of the types of waste expected to be generated when providing radiological support to contractor performing work in radiologically impacted areas, provides specific waste information and the Transportation and Disposal (T&D) Coordinator's associated responsibilities for each T&D activity, and includes a summary of sampling collection methods and procedures for the categorized waste generated on site.

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A.2 Waste Categories and Classification

This section describes the types of waste anticipated to be generated during the Basewide Radiological Support project.

The Site Superintendent will ensure waste from different sources are additionally segregated by each individual source. The T&D Coordinator will then review available information and determine whether the waste from different sources can be commingled for both cost and handling efficiency. Table A-1 includes information regarding waste accumulation methods and times.

A.2.1 Solid Waste

Site activities will consist of radiological support of non-radiological contractors in radiologically controlled or restricted areas, operation of the site portal monitor, and routine radiological compliance and controls activities. Waste generated during these activities will either be radiological or non-radiological in nature (Table A-2 and Table A-3). Practical measures will be implemented to minimize the generation of low-level radiological waste (LLRW; materials that contain radionuclides at greater than Hunters Point Action Levels) or low-level mixed waste (LLMW; waste containing both LLRW and levels of chemicals triggering a hazardous waste designation).

LLRW or LLMW that are anticipated may include, but are not limited to, the following:

- Soil
- Construction debris
- Personal protective equipment (PPE)

Non-radiological waste that are anticipated may include, but are not limited to, the following:

- Soil
- Construction debris
- Vegetation/green waste
- Refuse and debris (i.e., used sampling equipment)
- PPE

A.2.2 Liquid Waste

Waste liquids may be generated from decontamination water generated from equipment and personnel decontamination.

If liquid waste is generated, it will be stored in drums or tanks, or equivalent and appropriately labeled. When the drums or tanks are full or after 60 days, whichever comes first, the water will be sampled to determine if it meets sewer discharge requirements; if not, water analyses will serve as waste profiling per off-site disposal requirements.

A.3 Transportation and Disposal Activities

This section describes the specific T&D activities in a chronological sequence. Waste characterization activities will include radiological screening of waste debris and other materials prior to final disposition. Surveys will follow APTIM's U.S. Nuclear Regulatory Commission (NRC) and/or California License procedures for free-release. If classified as LLRW or LLMW, these wastes may be placed in containers provided by the Hunters Point Naval Shipyard LLRW waste broker. Disposal of radiological wastes will be handled through the U.S. Department of the Navy (Navy) LLRW Disposal Program. The Navy's LLRW waste broker will coordinate closely with the Navy's Radiological Affairs Support Office and be responsible for packaging, shipping, manifesting, and disposal of LLRW and LLMW. Table A-1 provides a summary of T&D activities and staff responsibilities.

A.3.1 Waste Accumulation and Storage

APTIM will segregate and accumulate wastes into the categories outlined in Table A-2. Soil will be stockpiled in areas designated by the Navy. The Site Superintendent will ensure wastes from different sources are additionally segregated by each individual source. The T&D Coordinator will then review available information and determine whether the wastes from different sources can be commingled for both cost and handling efficiency.

Radiologically impacted soil and/or debris will be placed in covered and lined roll-off containers (or other suitable container) which will be provided by the Navy's LLRW waste broker. The Navy's LLRW waste broker will assign a unique identification number to each individual container and will supervise and manage the tracking and contents of each bin.

Wastewater from the radioactive material decontamination area will be maintained separately from hazardous decontamination and dewatering wastewater. The wastewater will be managed as LLRW wastewater until the chemical and radiological characteristics are known.

Attachment A-1 provides the "Waste Inventory Log" that the Project Site Superintendent will use to track project waste. Attachment A-2 provides the "Waste Storage Area Inspection Checklist" that the Project Site Superintendent will use to inspect each waste storage area on a weekly basis.

A.3.1.1 Labeling and Posting of Containers Containing Radioactive Waste

Each waste container containing LLRW will be labeled and placed in a designated radioactive material storage area. The waste container will be labeled with a “Caution—Radioactive Material” label. The label will also note the maximum surface radiation level (measured in microroentgen per hour). The waste inventories will be managed under APTIM’s NRC or CA license until it is transferred to the Navy’s LLRW waste broker.

A.3.1.2 Waste Accumulation Areas for Radioactive Waste

APTIM will implement, at a minimum, the following requirements for radioactive waste stored on site within a designated radiologically impacted area:

- Display an industry standard placard and barrier materials with wording that includes the following, “Caution, Radiologically Controlled Area, Radioactive Materials Area, RWP Required for Entry, Authorized Personnel Only” (written in English and Spanish), at each radiological storage area every 50 feet (or 15 meters). The signs will be legible.
- Aisle space will be maintained to allow for the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to the area of facility operation in an emergency.
- The areas will be secured to prevent unauthorized access to the material.
- The following emergency equipment will be located or available to personnel during active waste management activities at each accumulation area:
- A device, such as a telephone or a hand-held two-way radio, capable of summoning emergency assistance will be available.
- Portable fire extinguishers, fire control equipment, spill control equipment, and decontamination equipment will be available.

Filled containers generated during performance of this work plan will be stored at the site where they were generated until the contained material can be characterized for packaging and disposal by the waste broker.

A.3.1.3 Waste Minimization

To minimize the volume of waste streams generated during the project, the following general guidelines will be followed:

- Waste material will not be cross-contaminated unnecessarily.
- Work will be planned ahead.
- Material may be stored in large containers, but the smallest reasonable container will be used to transport the material to the location where it is needed.
- Cleaning and extra sampling supplies will be maintained outside potentially contaminated areas to keep them clean and to minimize additional waste generation.
- Mixing of detergents or decontamination solutions will be performed outside potentially contaminated areas.
- When decontaminating radioactively contaminated material, every effort should be made to minimize the generation of mixed waste.
- Drop cloths or other absorbent material will be used to contain small spills or leaks.
- Contaminated material will not be placed with clean material.
- Wooden pallets inside the exclusion zone will be covered with plastic.
- Material and equipment will be decontaminated and reused when practical.
- Volume reduction techniques will be used when practicable.
- Waste containers will be verified to ensure that they are solidly packed to minimize the number of containers.

A.3.1.4 Inspections

While waste accumulation areas will be informally inspected on a daily basis, formal inspections of radiological controlled areas under APTIM NRC license will be inspected weekly. The Project Radiation Safety Officer or designee will conduct inspections. Inspections will be logged in a dedicated field notebook, and a weekly inspection checklist will be completed. The radiologically controlled areas will be inspected to ensure the following:

- The containers will be checked for good condition. If a container is not in good condition, the waste broker will be informed.
- The containers will be checked to ensure that they remain closed and secured at all times, except when adding or removing waste.
- The soil stockpiles will be checked to see they are properly identified/labeled and that their identification number is legible.
- The fence lines and gates will be checked for signs of break-ins or vandalism.

A.3.2 Waste Sampling, Characterization, and Profiling

The APTIM T&D Coordinator will coordinate with the APTIM Project Chemist to ensure that the proper analyses are requested for waste characterization and profiling purposes for the intended disposal facility, and that the proper sample containers, preservatives, and chain of custody (CoC) records are prepared for the field personnel to collect those samples. A California certified analytical laboratory will be used for waste characterization and profile analyses.

The T&D Coordinator will instruct the Project Chemist to retrieve representative samples for waste characterization and may request him/her to retrieve additional grab samples for comparison to applicable California Department of Toxic Substances Control (DTSC) land disposal restrictions. APTIM will characterize and profile waste streams. Waste profile soil sampling will be performed after soil waste is radiologically scanned and sampled. Sampling protocols will be followed, as described in Section 4.0.

Table A-3 outlines the minimum required sample types and analytical methods necessary for proper waste characterization and waste disposal acceptance for non-radiological waste.

According to requirements of Title 22 CCR, Section 66261.10, waste characteristics can be measured by an available standardized test method or be reasonably classified by

generators of waste based on their knowledge of the waste, provided that the waste has already been reliably tested or if there is documentation of chemicals used. A waste determined not to be a Resource Conservation and Recovery Act (RCRA) hazardous waste may still be considered a state regulated non RCRA hazardous waste (California hazardous waste). The state is broader in scope in its RCRA program in determining hazardous waste. Title 22 CCR, Section 66261.24(a)(2), lists the total threshold limit concentrations (TTLCs) and the soluble threshold limit concentrations (STLCs) for non RCRA hazardous waste. A waste is considered hazardous if its total concentrations exceed the TTLCs or if the extract concentrations from the waste extraction test exceed the STLCs. A waste extraction test is required when the total concentrations exceed the STLC by a factor of 10, but are less than the TTLCs. California also has additional hazardous waste classification criteria (including 96-hour fish bioassays) that may need to be considered on a case by case basis. Wastes determined to be hazardous wastes under California regulations and not under federal regulations are referred to as non RCRA hazardous wastes.

Changes in analyses or sampling frequency may be implemented based on the disposal facility requirements or at the discretion of the APTIM T&D Coordinator. Investigation-derived waste profile analyses, if necessary, will be completed on a standard 10-day turnaround time. Analytical results will be provided to the APTIM T&D Coordinator for evaluation and profiling and appropriate disposal. The designated Navy representative will review and sign waste profiles and manifests.

Waste profiles will be prepared for waste streams disposed of off site. The waste profiles will be submitted to the designated Navy representative for review and approval. Waste characterization sampling results and associated laboratory reports will accompany the waste profiles. The APTIM T&D Coordinator will prepare and submit the waste profile package and coordinate review and approval by the appropriate Navy personnel (Mr. Doug Delong, Caretaker Site Officer Representative).

Although PPE will not be sampled for waste characterization, it will be characterized based on knowledge of the process generating the waste.

Table A-3 lists the analytical methods for each waste stream to properly characterize the waste for acceptable disposal. APTIM's preliminary characterization and classification of the wastes that may be generated are outlined in Table A-4. Additional waste characterization may be performed as needed.

A.3.3 Waste U.S. Environmental Protection Agency Characterization and U.S. Department of Transportation Classification

Table A-4 outlines preliminary characterization and classification of the wastes generated at the site. Section 4.0 outlines information regarding sampling and analysis.

A.3.4 Selection of Transportation and Disposal Subcontractors

T&D subcontractors are evaluated during the procurement of subcontracts. The Transportation Subcontractor will have appropriate licenses, including an U.S. Environmental Protection Agency (EPA) Identification Number, U.S. Department of Transportation (DOT) Identification Number, and DOT Hazardous Material Registration Number, DTSC Hazardous Waste Registration, Department of Motor Vehicle Motor Carrier Permit, and Certified Health Physicist Hazardous Materials License. Hazardous material, including hazardous waste, will be properly classified, described, packaged, marked and labeled for shipment as required by applicable section of Title 49 Code of Federal Regulations (CFR) 171, 172, 173, 178, and 179 and 22 CCR 66262.10-66262.45, as required. Properly DOT-trained personnel will perform DOT functions.

The treatment/disposal facility(ies) will be compliant with EPA's "Off-Site Rule" (40 CFR 300.440) for applicable waste streams. Hunters Point Naval Shipyard is a Federal Superfund site regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and, therefore, the wastes must be disposed of at an appropriately approved facility. Disposal or recycling facilities are prequalified by APTIM.

A.3.5 Waste Manifest Package Preparation

The APTIM waste T&D subcontractor will prepare manifests for waste transported and disposed of off site. The manifests will be submitted to the designated Navy personnel for review prior to transportation of waste to the off-site facility. The signature of a Navy representative will be obtained prior to transporting the waste, and a copy of the manifest will accompany the load. In addition, truck tare (empty) and loaded weights will be obtained during waste hauling.

A.3.6 Waste Shipment and Tracking

Waste generated under this project, which will require off-site disposal by the Navy's basewide disposal contractors, include the following:

- Debris, PPE, and soil classified as unsuitable for reuse as backfill, based on radiological analysis, will be directly loaded into bins and transferred to the Navy's LLRW waste broker for disposal. Bins will be provided by the Navy's LLRW waste broker.
- Debris, PPE, and soil not classified as radiologically impacted will be moved outside the radiologically controlled area following approval from Radiological Affairs Support Office. APTIM will direct placement, characterization, and disposal of the releases debris, PPE, and/or soil.
- Wastewater will be characterized and profiled for appropriate off-site treatment and/or disposal.

APTIM will coordinate T&D of waste generated from the field activities through the Project Site Superintendent. Waste transportation will be in accordance with the DOT requirements and other federal, state, and local regulations. The APTIM T&D Coordinator will assist in the preparation of waste profiles, review the profiles, and coordinate approval by the Navy representative, as well as assist in waste loading activities. Table A-5 outlines the manifest package contents for each waste stream.

A.3.7 Waste Transportation and Disposal

APTIM will coordinate T&D of waste generated from the field activities through the Project Site Superintendent. Waste transportation will be in accordance with the DOT requirements and other federal, state, and local regulations. The APTIM T&D Coordinator will assist in the preparation of waste profiles, review the profiles, and coordinate approval by the Navy representative, as well as assist in waste loading activities. Table A-5 outlines the manifest package contents for each waste stream.

Soil that is deemed contaminated and/or hazardous based on waste profile sample concentrations will be disposed of off site at an appropriate disposal facility. Soil waste will be transported using a DOT certified transporter or waste hauler as determined and subcontracted by the disposal facility or APTIM. Procedures and requirements will follow appropriate Navy, state, local, and federal regulations. Trucks may be loaded only to the maximum tonnage as authorized by the DOT to prevent overloading and avoid weight issues. Off site disposal activities will be coordinated with the designated

Navy personnel. Trucks arriving on site (empty) and departing the site (full) will be tarped 100 percent of the time. This will reduce the potential for dust generation and possible cross contamination from debris. Trucks will be radiologically surveyed prior to leaving the controlled area.

A.4 Waste Characterization Sampling Collection Methods and Procedures

Waste characterization sampling collection methods and procedures for chemical (non-radiological) constituents are discussed in this section. Radiological characterization for soil and wastewater is described in the sampling and analysis plan (SAP; Appendix B to this work plan).

A.4.1 Sampling Strategy and Analytical Methods

Radiological characterization of soil and water samples is described in the SAP (Appendix B to this work plan). Once soil or wastewater has been radiologically released, chemical waste characterization will be performed.

One chemical waste characterization soil sample will be collected for every 500 cubic yards of waste soil. The waste characterization soil sample will be analyzed for the following parameters:

- Volatile organic compounds (VOCs)—EPA Method 5035/8260
- Semivolatile organic compounds (SVOCs)—EPA Method 8270
- Polychlorinated biphenyls (PCBs)—EPA Method 8082
- Total petroleum hydrocarbons (TPH)-extractable (as diesel and motor oil)—EPA Method 8015
- TPH-purgeable (as gasoline)—EPA Method 8015
- California Code of Regulations Title 22 metals (17)—6010/7471

If necessary, the following analyses will be performed to further characterize waste soil:

- STLCs by California Waste Extraction Test and EPA Method 6010
- Toxicity Characteristic Leaching Procedure by EPA Methods 1311/6010

Wastewater is not expected to be generated. If generated, wastewater will be reused if possible. Wastewater will be collected and stored in approved storage containers prior to sampling for reuse or disposal. If disposal becomes necessary, wastewater will either be discharged to the sanitary sewer system under an applicable San Francisco Public Utilities Department (SFPUD) wastewater discharge permit or will be transported off site for disposal at an approved facility. Wastewater will be sampled for radiological

characterization following the SAP (Appendix B to this work plan). In addition to radiological clearance, chemical characterization will be performed for discharge or off-site disposal purposes.

Water samples will be collected as required by the applicable SFPUD wastewater discharge permit. Typical analyses under this permit include the following:

- VOCs—EPA Method 8260
- SVOCs—EPA Method 8270
- PCBs—EPA Method 8082
- California Code of Regulations Title 22 Metals—EPA Method 6010/7470
- TPH-purgeable and -extractable—EPA Method 8015
- Total recoverable petroleum hydrocarbons—EPA Method 1664
- Total oil and grease—SM 5520
- Total suspended solids—SM 2540
- Ignitability—EPA Method 1010
- Total cyanide—SM 4500-CN
- Phenols—EPA Method 420.1
- Chemical oxygen demand—SM 5220
- Dissolved sulfide—SM 4500S2

If wastewater does not meet the requirements for SFPUD discharge, then analytical data will be used to dispose of wastewater at an appropriate off-site facility.

A.4.2 Sampling Procedure

This subsection discusses sampling procedures for soil and wastewater.

A.4.2.1 Soil Sampling

Soil samples will be collected using the following procedures:

1. Sampling personnel will don a new pair of disposable nitrile gloves immediately before collecting soil samples at each location.

2. Four individual grab samples will be collected from random locations over the 500 cubic yard area. The four individual grab samples will be composited by the subcontracting laboratory prior to analysis for SVOCs/Metals/PCB and TPH-extractable. One location will be selected for grab sample (EnCore® or TerraCore™ described in the following step) for VOCs and TPH-gasoline by EPA Method 5035.
3. Collect the soil sample into the appropriate sample containers using a disposable sample scoop.
    a. EnCore® or TerraCore™ samplers will be collected directly from freshly exposed soil surface.
    b. Obtain EnCore® or TerraCore™ device and T-Handle (or equivalent).
    c. The sample technician will test the plunger movement by pushing the plunger rod down until it rests against the tab.
    d. Apply EnCore® or TerraCore™ to freshly exposed surface soil. Holding the device with the T-Handle up and the cartridge down, insert the sampling device into the soil. The coring body must be full and checked to make sure the plunger end is seen in the viewing hole. Withdraw the sampling device from soil and wipe off excess dirt from cartridge body.
    e. For EnCore®, the cartridge core is capped while it is still on the T-Handle. Push or twist cap on until the groves are seated over the ridge of the coring body. Remove the capped sampler by pushing down locking lever on T-Handle and twisting and pulling sampler from T-Handle. The plunger is locked by rotating plunger rod until the wings rest against the tabs. Attach the label and seal the cartridge in the EnCore® sampler bag.
    f. The EnCore® sampler holding time is 48 hours. Soil samples are shipped to the laboratory for preservation or freezing within the 48-hour holding time. After preservation, the soil sample can be held up to 14 days for analysis.
    g. If using the TerraCore™, extrude the soil core into the preserved, pre-weighed sample vials prepared by the laboratory. Do not add additional labels to the pre-weighed vials. Use the laboratory provided laboratory.
4. Label, package, and prepare the samples for shipment to the laboratory. Place the samples in cold storage after collection.

5. Field documentation including field logbooks and CoC forms will be filled out during sample collection in accordance with the SAP (Appendix B to this work plan).
6. Radiologically release sample containers from radiological areas prior to shipment to the laboratory.

A.4.2.2 Wastewater Sampling

Wastewater samples, if necessary, will be collected from on-site storage containers using a disposable bailer. Samples will be collected using the following procedure:

1. Obtain an unused disposable bailer for each sample event.
2. Put on a new, clean, and chemical-resistant pair of disposable gloves.
3. Tie the bailer to a nylon cord or string.
4. Lower the bailer into the containment area. Allow sufficient time for the bailer to fill with water.
5. Retrieve the bailer and fill appropriate bottle(s) for analyses being requested.
6. If the storage container is equipped with sampling taps, samples may be collected at these locations.
7. Cap the bottle(s) and wipe moisture from the outside of the bottle(s).
8. Label, package, and prepare the samples for shipment to the laboratory. Place the samples in cold storage after collection.
9. Field documentation including field logbooks and CoC forms will be filled out during sample collection in accordance with the SAP (Appendix B to this work plan).
10. Radiologically release sample containers from radiological areas prior to shipment to the laboratory

A.4.3 Sample Custody and Documentation

Sampling information will be recorded on a CoC form and in a permanently bound field logbook. Entries will be legible and recorded in indelible ink.

A.4.4 Sample Numbering and Labeling

Samples will be uniquely numbered using a system that identifies the location, type, and sequential number. Waste samples will be numbered as follows:

- Waste soil: WS-01 through WS-XX (sequentially as needed to obtain correct frequency)
- Wastewater: WW-01 through WW-XX (sequentially as needed to obtain correct frequency)

Sample labels will be filled out with indelible ink and affixed to each sample container. Non-waterproof sample labels will be covered with clear tape. Sample containers will be placed in resealable plastic bags to protect the sample from moisture during transportation to the laboratory. Each sample container will be labeled with the following, at minimum:

- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock)
- Sampler's initials
- Analyses to be performed
- Preservation (if any)
- Location (i.e., site name)

A.4.5 Sampling Containers, Preservatives, and Holding Times

A list of the sample containers, preservatives, and holding time requirements for each analytical method is as follows:

Matrix	Analytical Group	Analytical Method Reference	Container	Preservation Requirements	Maximum Holding Time
Soil	VOCs	Preparation: 5035 Analysis: EPA 8260/8015	Three EnCore® devices or Three TerraCore™ devices or equivalent	Cool at 0–6°C	For Encore®: Analysis within 48 hours for preserved sample or extruded into an empty vial, and

Matrix	Analytical Group	Analytical Method Reference	Container	Preservation Requirements	Maximum Holding Time
Soil	TPH as gasoline	Preparation: 5035 Analysis: 8015	Three EnCore® devices or Three TerraCore™ devices or equivalent	Cool at 0–6°C	freeze (<-7°C) or lab preserve with sodium bisulfate (or other suitable solvent) within 48 hours of sampling with a holding time of 14 days. For TerraCore™: Samples extrude immediately upon collection into pre-weighed field preserved vials with appropriate solvent (methanol, water or sodium bisulfate) with a holding time of 14 days
Soil	SVOCs	Preparation: 3550/3540 Analysis: 8270	4- or 8-ounce amber glass jar with Teflon®-lined lid	Cool at 0–6°C	14 days to extraction; 40 days after extraction
Soil	PCBs	Preparation: 3550/3540 Analysis: 8082	4- or 8-ounce glass jar with Teflon®-lined lid	Cool at 0–6°C	14 days to extraction; 40 days after extraction
Soil	TPH as diesel and motor oil	Preparation: 3540 Analysis: 8015	4- or 8-ounce glass jar with Teflon®-lined lid	Cool at 0–6°C	14 days for extraction and 40 days for analysis

Matrix	Analytical Group	Analytical Method Reference	Container	Preservation Requirements	Maximum Holding Time
Soil	Metals	Preparation: 3050 Analysis: 6010/7471	4- or 8-ounce glass jar with Teflon®-lined lid	Cool at 0–6°C	180 days Mercury—28 days
Wastewater	VOCs	Preparation: 5030 Analysis: 8260	Three 40-mL vials, Teflon®-lined septum	Hydrochloric acid (HCl) to pH<2; cool at 0–6°C	14 days
Wastewater	SVOCs	Preparation: 3550/3510 Analysis: 8270 / 8270-SIM	Two 1-L amber bottles	Cool at 0–6°C	7 days to extraction; 40 days after extraction
Wastewater	PCBs	Preparation: 3550/3510 Analysis: 8082	Two 1-L amber bottles	Cool at 0–6°C	7 days to extraction; 40 days after extraction
Wastewater	Metals	Preparation: 3050 Analysis: 6010/7470	One minimum 500-mL HDPE bottle	Nitric acid to pH<2	180 days
Wastewater	TPH-purgeable	Preparation: 5030 Analysis: 8015	Three 40-mL vials, Teflon®-lined septum	HCl to pH<2; cool at 0–6°C	14 days
Wastewater	TPH-extractable	Preparation: 3520/3510 Analysis: 8015	Two 1-L amber bottles	Cool at 0–6°C	7 days to extraction; 40 days after extraction
Wastewater	Total recoverable petroleum hydrocarbons	Preparation: SM 5520 Analysis: 1664	Two 1-L amber bottles	H_2SO_4 to pH<2; cool at ≤6°C	14 days
Wastewater	Total oil and grease	Preparation and Analysis: SM 5520	Two 1-L amber bottles	H_2SO_4 to pH<2; cool at ≤6°C	14 days
Wastewater	Total suspended solids	Preparation and Analysis: SM 2540	One 500-mL HPDE	Cool at ≤6°C	7 days

Matrix	Analytical Group	Analytical Method Reference	Container	Preservation Requirements	Maximum Holding Time
Wastewater	Ignitability	Preparation: 9045 Analysis: 1010	One 500-mL HDPE	Cool at ≤6°C	Analyze as soon as possible
Wastewater	Total cyanide	Preparation and Analysis: SM 4500-CN	One 500-mL HPDE	NaOH to pH>10; cool at ≤6°C	14 days
Wastewater	Phenols	Preparation and Analysis: 420.1	Two 1-L amber bottles	H_2SO_4 to pH<2; cool at ≤6°C	14 days
Wastewater	Chemical oxygen demand	Preparation and Analysis: SM 5220	One 250-mL HPDE	H_2SO_4 to pH<2; cool at ≤6°C	28 days
Wastewater	Dissolved sulfide	Preparation and Analysis: SM 4500S2	One 500-mL HPDE	NaOH and ZnAc to pH>10; cool at ≤6°C	7 days

Notes:

<	less than
≤	less than or equal to
>	greater than
°C	degree Celsius
EPA	U.S. Environmental Protection Agency
H_2SO_4	sulfuric acid
HCl	hydrochloride acid
HPDE	high-density polyethylene
L	liter
mL	milliliter
NaOH	sodium hydroxide
PCB	polychlorinated biphenyl
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
VOC	volatile organic compound

A.4.6 Quality Control

Field quality control samples will consist of temperature blanks only for waste samples. Field duplicates, matrix spikes, and equipment rinse blanks will not be collected with

waste samples. Each cooler will be shipped with a temperature blank. A temperature blank is a sample container filled with tap water and stored in the cooler during sample collection and transportation. The laboratory will record the temperature of the temperature blank immediately upon receipt of the samples.

A.4.7 Sample Packaging and Shipment

After sample collection, sample labels will be affixed to each sample container. Each sample will be placed in a resealable plastic bag to keep the sample container and the label dry. Glass sample containers will be protected with bubble wrap (or other cushioning material) to prevent breakage. A temperature blank will be placed in every cooler with samples.

Samples to be shipped by commercial carrier will be packed in a sample cooler lined with a plastic bag. Ice (double bagged) will be added to the cooler in sufficient quantity to keep the samples cooled to 0 to 6 degrees Celsius for the duration of the shipment to the laboratory. Sample cooler drain spouts will be taped from the inside and outside of the cooler to prevent leakage. Saturday deliveries will be coordinated with the laboratory.

If samples are picked up by a laboratory courier service, the CoC form will be completed and signed by the laboratory courier. The cooler will then be released to the courier for transportation to the laboratory.

If a commercial carrier is used, the CoC form will include the air-bill number in the “Transfers Accepted By” column and will be sealed in a resealable bag. The CoC form will then be taped to the inside of the sample cooler lid. The cooler will be taped shut with strapping tape, and two custody seals will be taped across the cooler lid. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The samples will then be shipped to the analytical laboratory.

The shipping of samples to the analytical laboratory by land delivery services will be performed according to the DOT regulations. The International Air Transportation Association regulations will be adhered to when shipping samples by air courier services. Transportation methods will be selected to assure that the samples arrive at the laboratory in time to permit testing according to established holding times and project schedules. No samples will be accepted by the receiving laboratory without a properly prepared CoC record and properly labeled and sealed shipping container(s).

A.4.8 Quality Assurance

Analytical data will be obtained using published, standard methods in a U.S. Department of Defense Environmental Laboratory Accreditation Program-certified laboratory. Detection levels and quality assurance/quality control methods will be in accordance with the U.S. Department of Defense *Quality Systems Manual for Environmental Laboratories* (2018) and the listed EPA methods.

A.4.9 Documentation

Waste data, including analytical data, waste profiles, and manifests, will be submitted to the Navy.

A.5 References

California Code of Regulation, Title 22, Social Security, Division 4.5, “Environmental Health Standards for the Management of Hazardous Waste,” Chapter 12, “Standards Applicable to Generators of Hazardous Waste,” current.

Code of Federal Regulations, Title 40, Part 300, *National Oil and Hazardous Substances Pollution Contingency Plan*, U.S. Government Printing Office, Washington, D.C.

U.S. Department of Defense, 2018, *Quality Systems Manual for Environmental Laboratories*, Version 5.1.1, February.

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TABLES

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Table A-1: Synopsis of T&D Activities and Staff Responsibilities

Step Number	T&D Activity	Site Superintendent Responsibilities	T&D Coordinator Responsibilities
1	Waste Accumulation and Storage	Mark and label waste containers, if present. Prepare and maintain "Waste Inventory Log." Inspect storage areas; prepare and maintain "Waste Storage Area Inspection Checklist" weekly. Ensure waste accumulation times do not exceed regulatory thresholds.	Provide marking and labeling requirements. Monitor waste inventory logs. Monitor waste storage area inspection checklists.
2	Waste Analysis	Assist Project Chemist in retrieving samples. Ship samples to laboratory and disposal facilities in accordance with DOT and IATA requirements. Provide analytical data to T&D Coordinator.	Determine waste characterization and disposal facility analyses requirements. Provide waste characterization and disposal facility analysis requirements to Project Chemist. Determine if samples are regulated by DOT and IATA, and provide DOT and IATA requirements to Project Chemist.
3	Waste EPA/DTSC Characterization and DOT Classification	Provide site history and waste generation sources to T&D Coordinator. Verify accuracy of waste labels.	Characterize and classify each waste stream.
4	Selection of T&D Subcontractors	Provide T&D Coordinator with project schedule.	Determine T&D options. Prepare purchase order requisition package. Evaluate bidding vendors. Recommend subcontractors.

Step Number	T&D Activity	Site Superintendent Responsibilities	T&D Coordinator Responsibilities
5	Waste Manifest Package Preparation	Obtain generator approval and signatures. Submit to disposal facility and track approval time.	Prepare disposal facility waste profiles, land disposal restriction forms, and template manifests. Obtain disposal facility letters of commitment.
6	Waste Shipment and Tracking	Schedule shipment. Inspect transportation containers, vehicles, and drivers. Obtain generator and transporter signatures on each manifest and land disposal restriction form.	Prepare/review manifests and land disposal restriction forms. Distribute copies of executed manifests. Track shipment to disposal facility. Obtain disposal facility signed manifests.
7	Waste Treatment and Disposal	No action required.	Obtain certificates of disposal/treatment, and weight tickets.

Notes:

DOT	U.S. Department of Transportation.
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
IATA	International Air Transport Association
T&D	transportation and disposal

Table A-2: Waste Accumulation Methods and Times

Waste	Accumulation Method	Maximum Accumulation Times
LLRW (from soil and building screening)	Temporary waste pile; roll-off container	Not applicable for nonhazardous; 90 days maximum for hazardous according to 22 CCR Section 66262.34
PPE and Visqueen®	Roll-off container; plastic bag	Not applicable for nonhazardous; 90 days maximum for hazardous according to 22 CCR Section 66262.34
Wastewater (rinsate from equipment decon activities and/or dewatering of excavations)	Temporary storage tank; UN-spec drums	Not applicable for nonhazardous; 90 days maximum for hazardous according to 22 CCR Section 66262.34
Nonhazardous soil	Temporary waste pile; roll-off container	Not applicable for nonhazardous
California-only hazardous soil	Temporary waste pile; roll-off container	90 days maximum for hazardous according to 22 CCR Section 66262.34
RCRA hazardous soil	Temporary waste pile; roll-off container	90 days maximum for hazardous according to 22 CCR Section 66262.34 and 40 CFR 262.34
Construction debris (i.e., metal, wood, plastic, paper, piping), non-ACM	Temporary waste pile; roll-off bin	Not applicable for nonhazardous

Notes:
California Code of Regulation, Title 22, Social Security; Division 4.5, Environmental Health Standards for the Management of Hazardous Waste; Chapter 12, Standards Applicable to Generators of Hazardous Waste; current through April 10, 2009.

ACM asbestos-containing material
CCR California Code of Regulations
CFR Code of Federal Regulations
LLRW low-level radiological waste
PPE personal protective equipment
RCRA Resource Conservation and Recovery Act

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Table A-3: Waste Sample Types and Analyses

Waste	Sample Type	Analytical Methods
LLRW (from soil and debris screening)	Representative	Surface contamination and gamma scanning surveys Gamma spectroscopy for radium-226 and cesium-137 (EPA Method 901.1) Other radionuclide-specific analyses as required
PPE and Visqueen®	No sampling; personal protective equipment will be characterized based on associated materials	Will infer from analytical data representing the soil
Wastewater (from equipment decon activities and/or dewatering of excavations)	Grab sample	Radium-226/228 (EPA Methods 903/904) Other radionuclide-specific analyses as required
Non-Radiological Wastewater (i.e., rinsate/decon)	Grab sample	EPA 8260 VOC; EPA 8270 SVOC; EPA 8082 PCB; EPA 8015B Gas; EPA 8015B Diesel/MO; EPA 6010 Heavy Metals; SM 5520B total oil and grease; EPA 9045 pH; SM 2540D TSS; EPA 101 Ignitability; SM 4500-CN total cyanide; EPA 420.1 phenols; SM 5220C COD; SM 4500S dissolved sulfides
Nonhazardous soil	Composite sample (one 4-point per 500 cubic yards)	EPA 8260 VOC; EPA 8270 SVOC; EPA 8082 PCB; EPA 8015B Gas; EPA 8015B Diesel/MO; EPA 6010 Heavy Metals
California-only hazardous soil	Composite sample (one 4-point per 500 cubic yards)	EPA 8260 VOC; EPA8270 SVOC; EPA 8082 PCB; EPA8015B Gas; EPA 8015B Diesel/MO; EPA 6010 Heavy Metals
RCRA hazardous soil	Composite sample (one 4-point per 500 cubic yards)	EPA-8260 VOC; EPA8270 SVOC; EPA 8082 PCB; EPA 8015B Gas; EPA 8015B Diesel/MO; EPA 6010 Heavy Metals
Construction debris (i.e., metal, wood, plastic, paper, piping), non-ACM	No sampling	N/A

Notes:

ACM	asbestos-containing material
COD	chemical oxygen demand
EPA	U.S. Environmental Protection Agency
LLRW	low-level radiological waste
MO	motor oil
N/A	not applicable
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
SVOC	semivolatile organic compound
TSS	total suspended solids
VOC	volatile organic compound

Table A-4: Preliminary Characterization and Classification

Waste Stream	EPA/DTSC Characterization	DOT Classification
LLRW or LLMW (from soil and building screening)	Class A LLRW	Class 7 or not regulated
PPE and Visqueen®	Nonhazardous	Non-regulated
Wastewater	Nonhazardous	Non-regulated
Nonhazardous soil	Nonhazardous	Non-regulated
California-only hazardous soil	Hazardous	Non-regulated
RCRA hazardous soil	Hazardous	Class 9 (other regulated material)
Construction debris (i.e., metal, wood, plastic, paper, piping), non-ACM	Nonhazardous	Non-regulated

Notes:

ACM	asbestos-containing material
DOT	U.S. Department of Transportation.
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
LLMW	low-level mixed waste
LLRW	low-level radiological waste
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act

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Table A-5: Typical Waste Manifest Packages for Potential Waste Disposal Facilities (Non-Radiological Waste)

Waste Stream	EPA/DTSC Characterization	Potential Disposal Methods and Facilities	Manifest Package Contents
Nonhazardous soil	Nonhazardous	Direct Landfill Waste Management—Altamont Republic Services—Hay Road Landfill Allied Waste—Keller Canyon or Forward Landfill	TSDF waste profile form Nonhazardous waste manifest
California-only hazardous soil	Hazardous	Direct Landfill US Ecology—Beatty, Nevada Clean Harbors—Buttonwillow, California Chemical Waste Management—Kettleman Hills, California	TSDF waste profile form Hazardous waste manifest and associated land disposal restriction notifications
RCRA hazardous soil	Hazardous	Treatment & Landfill US Ecology—Beatty, Nevada Clean Harbors—Buttonwillow, California Chemical Waste Management—Kettleman Hills, California	TSDF waste profile form Hazardous waste manifest and associated land disposal restriction notifications
Construction debris (metal, wood, plastic, paper, piping, etc.), non-ACM	Nonhazardous	Waste Management—Altamont Allied Waste—Keller Canyon or Forward Landfill Republic Services—Hay Road Landfill	TSDF waste profile form Nonhazardous waste manifest
Water (i.e., rinsate/ decon)	Nonhazardous	Discharge POTW—San Francisco, California Disposal Waste Management—Altamont Seimen's Water Technologies—Vernon, California	Special Discharge Permit TSDF Waste profile form Nonhazardous waste manifest

Notes:

ACM	asbestos-containing material
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
POTW	publicly owned treatment works
TSDF	treatment, storage, and disposal facility

ATTACHMENT A-1
WASTE INVENTORY LOG

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Waste Inventory Log

Aptim Federal Services, LLC
Contract Number: N62473-17-D-0006; Task Order: N6247321F5082
Basewide Operation, Maintenance, and Radiological Support

Date of Inventory Inspection: _____ Inspected by: _____

Container Number/Type/ Volume	Storage Location/ Stockpile #	Generation Date	Waste Description/ Source	Date Removed from Site

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ATTACHMENT A-2
WASTE STORAGE AREA INSPECTION CHECKLIST

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Waste Storage Area
Weekly Inspection Checklist

Aptim Federal Services, LLC
Contract Number: N62473-17-D-0006; Task Order: N6247321F5082
Basewide Operation, Maintenance, and Radiological Support

Inspected by: _____ Date: _____ Time: _____

	Yes	No	Corrective Action	Date Corrected
Area posted with appropriate hazard and cautionary signs	☐	☐	_____	_____
Area free of spills?	☐	☐	_____	_____
Liquids stored in proper secondary containment?	☐	☐	_____	_____
Secondary containment basins free of liquids, snow, and debris?	☐	☐	_____	_____
Containers compatible with waste being stored?	☐	☐	_____	_____
Containers properly sealed (lids on, rings in place, bins covered, etc.)?	☐	☐	_____	_____
Containers properly labeled?	☐	☐	_____	_____
Labels easily visible for inspection?	☐	☐	_____	_____
Accumulation start dates present on labels?	☐	☐	_____	_____
Accumulation start dates with storage time limit (e.g., 90 days)?	☐	☐	_____	_____
Information on labels is legible not faded and required information is present?	☐	☐	_____	_____
Adequate aisle space for drums (minimum 22 inches)?	☐	☐	_____	_____
Aisles and doorways free of obstructions?	☐	☐	_____	_____
Containers free of leaks, dents, or deterioration including structural defects and rusting?	☐	☐	_____	_____
Adequate separation of incompatible materials?	☐	☐	_____	_____
Tops of containers free of standing water?	☐	☐	_____	_____

Notes: _____

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APPENDIX B
ABBREVIATED SAMPLING AND ANALYSIS PLAN (DATED DECEMBER 2021)

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Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
San Diego, CA

Appendix B

Final, Abbreviated Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan)

Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

December 2021

Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
San Diego, CA

Appendix B

Final, Abbreviated Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan)

Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

December 2021

DCN: APTM-0006-5082-0010

Prepared for:

Department of the Navy
Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
33000 Nixie Way, Bldg. 50
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Contract Number: N62473-17-D-0006; Task Order: N6247321F5082

Table of Contents

Table of Contents B-5
List of Attachments B-10
List of Figures B-10
Acronyms and Abbreviations B-11
Executive Summary B-15
B.1 SAP Worksheet #1: Title and Approval Page B-17
B.2 SAP Worksheet #2: SAP Identifying Information B-19
B.3 SAP Worksheet #3: Distribution List B-21
B.4 SAP Worksheet #4: Project Personnel Sign-Off Sheet B-23
B.5 SAP Worksheet #5: Project Organization Chart B-25
B.6 SAP Worksheet #6: Communication Pathways B-27
B.7 SAP Worksheet #7: Personnel Responsibilities and Qualifications Table B-29
B.8 SAP Worksheet #8: Special Personnel Training Requirements Table B-31
B.9 SAP Worksheet #9: Project Scoping Session Participants Sheet B-33
B.10 SAP Worksheet #10: Problem Definition B-35
B.10.1 Site History and Description B-35
B.11 SAP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements B-37
B.12 SAP Worksheet #12: Measurement Performance Criteria Table—Field Quality Control Samples (Soil—Backfill Material Only) B-41
B.13 SAP Worksheet #13: Secondary Data Criteria and Limitations Table B-43
B.14 SAP Worksheet #14: Summary of Project Tasks B-45
B.14.1 Scope of Work B-45
B.14.2 Sample Collection Methods and Procedures B-45
B.14.3 Analytical Requirements B-45
B.14.4 Quality Control Tasks B-45
B.14.5 Data Recording and Transfer B-45
B.14.5.1 Hard Copy Deliverables B-45
B.14.5.2 Electronic Deliverables B-46

Table of Contents (continued)

B.14.6 Data Management B-46
B.14.6.1 Data Reduction, Verification, and Reporting B-46
B.14.6.2 Data Reduction B-46
B.14.6.3 Laboratory Data Verification and Review B-47
B.14.6.3.1 Level 1. Laboratory Technical (Peer) Data Review B-47
B.14.6.3.2 Level 2. Laboratory Technical Data Review B-48
B.14.6.3.3 Level 3. Laboratory Administrative Quality Assurance Data Review B-49
B.14.7 Data Validation B-49
B.15 SAP Worksheet #15: Reference Limits and Evaluation Tables B-51
B.15.1 SAP Worksheet #15.1: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Gamma Isotopes) B-51
B.15.2 SAP Worksheet #15.2: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Strontium-90) B-53
B.15.3 SAP Worksheet #15.3: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Alpha Isotopes) B-54
B.15.4 SAP Worksheet #15.4: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Tritium) B-55
B.15.5 SAP Worksheet #15.5: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix) B-56
B.15.6 SAP Worksheet #15.6: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Strontium-90) B-58
B.15.7 SAP Worksheet #15.7: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Alpha Isotopes) B-59
B.15.8 SAP Worksheet #15.8: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Tritium) B-60
B.15.9 SAP Worksheet #15.9: Reference Limits and Evaluation Table—Site Contaminants (Swipe Matrix—Gross Alpha/Gross Beta) B-61
B.15.10 SAP Worksheet #15.10—Backfill Material Reference Limits and Evaluation Table—Volatile Organic Compounds B-62
B.15.11 SAP Worksheet #15.11—Backfill Materials Reference Limits and Evaluation Table—Metals (Soil Matrix) B-65
B.15.12 SAP Worksheet #15.12—Backfill Materials Reference Limits and Evaluation Table—Pesticides and Polychlorinated Biphenyls B-67

Table of Contents (continued)

B.15.13 SAP Worksheet #15.13—Backfill Materials Reference Limits and Evaluation Table—Semivolatile Organic Compounds.....B-69

B.15.14 SAP Worksheet #15.14—Backfill Materials Reference Limits and Evaluation Table—Polycyclic Aromatic Hydrocarbons (Soil Matrix) B-71

B.15.15 SAP Worksheet #15.15—Backfill Materials Reference Limits and Evaluation Table—Total Petroleum Hydrocarbons (Soil Matrix).....B-72

B.15.16 SAP Worksheet #15.16—Backfill Materials Reference Limits and Evaluation Table—Asbestos (Soil Matrix).....B-73

B.16 SAP Worksheet #16: Project Schedule/Timeline Table B-75

B.17 SAP Worksheet #17: Sampling Design and Rationale.....B-77

B.17.1 Waste Soil and Wastewater Sampling.....B-77

B.17.2 Wastewater.....B-83

B.17.3 Import Borrow Source Soil.....B-83

B.18 SAP Worksheet #18: Sampling Locations and Methods/Standard Operating Procedures Requirements Table.....B-87

B.19 SAP Worksheet #19: Analytical Standard Operating Procedures Requirements Table.....B-89

B.20 SAP Worksheet #20: Field Quality Control Sample Summary Table B-93

B.21 SAP Worksheet #21: Project Sampling Standard Operating Procedures References Table.....B-95

B.21.1 Shallow Soil Sampling from Borrow Soil or Radiological Screening Yard Pads.....B-95

B.21.1.1 Wastewater Sampling B-95

B.21.2 EnCore® or Terra Core™ Soil Sampling for Volatile Organic Compounds B-96

B.21.3 Soil Sampling with a Slide Hammer.....B-97

B.21.4 Equipment Decontamination.....B-97

B.22 SAP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection Table.....B-99

B.23 SAP Worksheet #23: Analytical Standard Operating Procedures References Table B-101

Table of Contents (continued)

B.24 SAP Worksheet #24: Analytical Instrument Calibration Tables B-103

B.24.1 SAP Worksheet #24.1: Analytical Instrument Calibration Table (Gamma Spectrometry) B-103

B.24.2 SAP Worksheet #24.2: Analytical Instrument Calibration Table (Alpha Spectrometry) B-105

B.24.3 SAP Worksheet #24.3: Analytical Instrument Calibration—Chemical Analyses B-107

B.25 SAP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table B-111

B.26 SAP Worksheet #26: Sample Handling System.....B-113

B.27 SAP Worksheet #27: Sample Custody Requirements Table.....B-115

B.27.1 Sample Custody and Documentation B-115

B.27.2 Sample Labeling B-115

B.27.3 Chain-of-Custody B-115

B.27.4 Sample Packing and Shipment.....B-116

B.27.5 Field Logbooks B-117

B.27.6 Document Corrections B-118

B.28 SAP Worksheet #28: Laboratory Quality Control Samples Tables.....B-119

B.28.1 SAP Worksheet #28.1: Laboratory Quality Control Samples Table (Gamma Isotopes) B-119

B.28.2 SAP Worksheet #28.2: Laboratory Quality Control Samples Table (Gas Flow Proportional Counting Isotopes).....B-120

B.28.3 SAP Worksheet #28.3: Laboratory Quality Control Samples Table (Alpha Spectroscopy).....B-122

B.28.4 SAP Worksheet #28.4: Laboratory Quality Control Samples Table—EPA Method 8015.....B-123

B.28.5 SAP Worksheet #28.5: Laboratory Quality Control Samples Table—Inductively Coupled Plasma/Mass Spectrometry.....B-124

B.28.6 SAP Worksheet #28.6: Laboratory Quality Control Samples Table—EPA Method 8270.....B-126

B.28.7 SAP Worksheet #28.7: Laboratory Quality Control Samples Table—EPA Methods 8081/8082 .....B-127

B.28.8 SAP Worksheet #28.8: Laboratory Quality Control Samples Table—Mercury.....B-128

Table of Contents (continued)

B.28.9 SAP Worksheet #28.9: Laboratory Quality Control Samples Table—EPA Method 8260 ..... B-129

B.28.10 SAP Worksheet #28.10: Laboratory Quality Control Samples Table—Asbestos B-130

B.29 SAP Worksheet #29: Project Documents and Records Table B-131

B.30 SAP Worksheet #30: Analytical Services Table B-133

B.31 SAP Worksheet #31: Planned Project Assessments Table B-135

B.32 SAP Worksheet #32: Assessment Findings and Corrective Action Responses B-137

B.33 SAP Worksheet #33: QA Management Reports Table B-139

B.34 SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table B-141

B.34.1 Validation of Laboratory Data B-143

B.34.2 Stage 2B and Stage 3 Data Validation Criteria and Checklist B-144

B.35 SAP Worksheet #37: Usability Assessment B-149

B.35.1 Data Quality Assessment Report B-149

B.35.2 Data Quality Indicators B-149

B.35.2.1 Precision B-149

B.35.2.2 Accuracy B-150

B.35.2.3 Representativeness B-151

B.35.2.4 Comparability B-151

B.35.2.5 Completeness B-152

B.35.3 Sensitivity B-152

B.36 References B-155

List of Attachments

Attachment B-1: Field Forms.....B-161

Attachment B-2: Control Limits, Certifications, and Analytical Standard Operating Procedures B-167

List of Figures

Figure B-1: Radiological Areas Under Contract B-159

Acronyms and Abbreviations

°C ..... degree Celsius
% ..... percent
< ..... less than
> ..... greater than
± ..... plus or minus
≤ ..... less than or equal to
≥ ..... greater than or equal to
^{90}Sr strontium-90
^{137}Cs cesium-137
^{226}Ra radium-226
APTIM ..... Aptim Federal Services, LLC
BSC ..... background subtraction count
CARB ..... California Air Resources Board
CCV ..... continuing calibration verification
CERCLA ..... Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC ..... chain-of-custody
DL ..... detection limit
DLC ..... decision level concentration
DoD ..... U.S. Department of Defense
DQA ..... data quality assessment
DQO ..... data quality objective
DTSC ..... California Department of Toxic Substances Control
EDD ..... electronic data deliverable
EPA ..... U.S. Environmental Protection Agency
FWHM ..... full width at half maximum
GFPC ..... gas flow proportional counting
H&S ..... health and safety
HPNS ..... Hunters Point Naval Shipyard

Acronyms and Abbreviations (continued)

ICAL ..... initial calibration
ICS ..... interference check solution
ICV ..... initial calibration verification
ID ..... identification
IS ..... internal standard
keV ..... kiloelectron volt
LCS ..... laboratory control sample
LOD ..... limit of detection
LOQ ..... limit of quantitation
MARLAP ..... *Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)*
MARSSIM ..... *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*
MB ..... method blank
MS ..... matrix spike
MSD ..... matrix spike duplicate
NAVFAC SW ..... Naval Facilities Engineering Command Southwest
Navy ..... U.S. Department of the Navy
NRC ..... U.S. Nuclear Regulatory Commission
OCP ..... organochlorine pesticides
OSHA ..... Occupational Safety and Health Administration
PAH ..... polycyclic aromatic hydrocarbon
PCB ..... polychlorinated biphenyl
pCi/g ..... picocurie per gram
PM ..... project manager
POC ..... point of contact
QA ..... quality assurance
QAO ..... Quality Assurance Officer
QC ..... quality control
QSM ..... *Quality Systems Manual for Environmental Laboratories, Version 5.3*

Acronyms and Abbreviations (continued)

RER ..... duplicate error ratio

RPD ..... relative percent difference

RPM ..... Remedial Project Manager

RPP ..... *Radiation Protection Plan, Basewide Operation, Maintenance and Radiological Support, Former Hunters Point Naval Shipyard, San Francisco, California*, California

RSO ..... Radiation Safety Officer

RT ..... retention time

SAP ..... sampling and analysis plan

SOP ..... standard operating procedure

SSHO ..... Site Safety and Health Officer

SVOC ..... semivolatile organic compound

TPH ..... total petroleum hydrocarbons

UFP-QAPP ..... *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data*

VOC ..... volatile organic compound

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Executive Summary

This abbreviated sampling and analysis plan has been prepared by Aptim Federal Services, LLC to support sampling and analytical tasks associated with the basewide radiological support at Hunters Point Naval Shipyard. Project work includes the performing radiological support activities for non-radiological contractor (including soil and water sampling) and operation of the site portal monitor, various operation and maintenance activities, and truck wash.

Sampling activities will include radiological soil or water sampling in support of field activities performed by a non-radiological contractor. These activities will be performed in accordance with the project work plan, State of California Radioactive Materials License Number 7889-07, U.S. Nuclear Regulatory Commission License 20-31340-01, and the *Radiation Protection Plan, Basewide Operation, Maintenance, and Radiological Support, Former Hunters Point Naval Shipyard, San Francisco, California* (Aptim Federal Services, LLC, 2021). No chemical sampling is anticipated for this portion of the work scope. However, if clean borrow rock or soil is needed to support operation and maintenance, then chemical sampling will be performed to verify clean material is used for these tasks.

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B.1 SAP Worksheet #1: Title and Approval Page

Appendix B

Final, Abbreviated Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan)

Work Plan

Basewide Operation, Maintenance, and Radiological Support

Hunters Point Naval Shipyard, San Francisco, CA

December 2021

Prepared for:

Department of the Navy
Naval Facilities Engineering Systems Command Southwest
BRAC PMO West
33000 Nixie Way, Bldg. 50
San Diego, CA 92147

Prepared by:

Aptim Federal Services, LLC
4005 Port Chicago Highway, Suite 200
Concord, CA 94520

k Order: N6247321F5082

December 17, 2021
Date

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B.2 SAP Worksheet #2: SAP Identifying Information

Site Name/Number:	**Basewide Operation, Maintenance and Radiological Support at Hunters Point Naval Shipyard (HPNS)**
Contractor Name:	**Aptim Federal Services, LLC (APTIM)**
Contract Number:	**N62473-17-D-0006**
Contract Title:	**RADMAC II**
Work Assignment Number (optional):	**Contract Task Order N6247321F5082**

1. This abbreviated sampling and analysis plan (SAP) was prepared in accordance with the *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs* (UFP-QAPP; U.S. Environmental Protection Agency [EPA], 2005) and *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, Office of Environmental Information* (EPA, 2001). With additional guidance from the following publications:
   a. *Quality Systems Manual for Environmental Laboratories, Version 5.3* (QSM; U.S. Department of Defense [DoD], 2019a)
   b. *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006)
   c. *Environmental Work Instruction EVR.2—Review, Approval, Revision, and Amendment of Sampling and Analysis Plans* (Naval Facilities Engineering Command Southwest [NAVFAC SW], 2011)
   d. *Environmental Work Instruction EVR.4—Implementing and Maintaining the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Administrative Record and Compendium at NAVFAC Southwest* (NAVFAC SW, 2007)
   e. *Environmental Work Instruction EVR.6—Environmental Data Management and Required Electronic Delivery Standards* (NAVFAC SW, 2005)
2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

3. This is a project-specific SAP and includes only specifics about radiological analyses.
4. List dates of scoping sessions that were held: Thursday, July 29, 2021 (Project Kick-Off Meeting)
5. List dates and titles of SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
No relevant documents available	

6. List organizational partners (stakeholders) and connection with lead organization:
   Example for project-specific SAPs:

Oversight by the California Department of Toxic Substances Control (DTSC)
Oversight by the California Department of Public Health, Division of Drinking Water and Environmental Management
Oversight by the California Regional Water Quality Control Board

7. Lead organization

U.S. Department of the Navy (Navy)

8. If required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

This is a SAP for basewide radiological support services and does not require QAO or regulatory review.

B.3 SAP Worksheet #3: Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	Email Address or Mailing Address

Name of SAP				

B.4 SAP Worksheet #4: Project Personnel Sign-Off Sheet

		re/Email Receipt	SAP Section Reviewed	Date SAP Read

Note:
The signed SAP Worksheet #4 will be stored in the on-site project files, and then will be transferred to the APTIM Concord, California home office file storage at completion of fieldwork.

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B.5 SAP Worksheet #5: Project Organization Chart

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B.6 SAP Worksheet #6: Communication Pathways

			Telephone Number	Procedure
				Materials and information about the project will be forwarded to the RPM by the PM or Asst. PM.
				The Project Chemist is responsible for documenting field changes related to sampling. The Project Chemist or Program Chemist is also responsible for generating SAP amendments as necessary for approval by the Navy Quality Assurance Officer (QAO). The Project Chemist oversees the documentation, notification, and corrective actions associated with project management issues in writing. Due to the potential impact field changes and SAP amendments may have on the project, the Project Chemist is to be notified of such issues within 24 hours.
				In general, the Project Chemist is the POC for sampling and chemistry issues and the Project QC Manager is the POC for other quality issues. If quality issues are not resolved at the project level (in consultation with the PM, Project Site Superintendent, Technical Lead, etc.), then the issue will be elevated to the Program Chemist or Program QC Manager). The Program Chemist or designee will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project QC Manager or Project Chemist oversees the documentation, notification, and corrective actions associated with the quality assurance (QA) issues in writing.
				The Project Chemist is the POC for sampling and chemistry issues. If sampling issues are not resolved at the project level (in consultation with the PM and other staff), then the issue will be elevated to the Program Chemist (Rose Condit) or Program QC Manager. The Program Chemist or Program QC Manager will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the QA issues in writing. Due to the potential impact, sampling issues may have on the project the Project Chemist is to be notified of sampling issues within 24 hours.
				The Project Chemist is the POC for laboratory issues. The project Data Manager is the POC for electronic data deliverables (EDD). If laboratory issues are not resolved with the Project Chemist or Data Manager, then the issue will be elevated to the Program Chemist. If significant problems are identified from the laboratory that will impact the usability of the data, the Project Chemist should inform the PM, Navy RPM, and other parties as applicable within 24 hours of discovery or by the next business day. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the laboratory issue in writing.
				If significant problems are identified by the laboratory or the project team that impact the usability of the data (i.e., the data is rejected or the DQOs are not met), the Program Chemist will notify the NAVFAC SW RPM and the NAVFAC SW QAO within 24 hours or the next business day.

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or Email	Procedure
				The PM is the POC for project site activities such as scheduling, staffing, subcontractors, fieldwork, etc. The Assistant PM, in consultation with the PM and Navy RPM, if necessary, will resolve project site issues. Upon resolution, the PM or Assistant PM oversees the documentation, notification, and corrective actions associated with site issues in writing. The PM or Assistant PM is to be notified of site issues within 24 hours.
				The Project SSHO is the POC for H&S issues. If H&S issues are not resolved at the project level (in consultation with the PM, Project Site Superintendent, Technical Lead, etc.), then the issue will be elevated to the Program SSHO. The Program SSHO or designee will seek additional guidance or approval from the Navy SSHO, if necessary. Upon resolution, the Project SSHO oversees the documentation, notification, and corrective actions associated with the issue in writing. Due to the potential seriousness of H&S issues, the SSHO is to be notified of H&S issues immediately.
				Employees have the right and duty to stop work when conditions are unsafe, or when established safety procedures are being disregarded. Whenever an employee determines that workplace conditions present an immediate uncontrolled risk of injury or illness, immediate resolution with the appropriate supervisor will be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the employee is authorized and required to issue a Stop Work Order. The specific activity or operation in question will be discontinued until the issue is resolved.

B.7 SAP Worksheet #7: Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibility
			Manages governmental oversight of the project. Manages project funding and scope. Coordinates project documents review. Primary contact and liaison with regulatory agencies. Responsible for technical oversight of the project.
			Manages oversight of the project for APTIM. POC for communication with the Navy RPM and Navy contracts. Ensures that requirements of project contract are attained in a manner consistent with project plans. Oversees planning, execution, and conclusion of project activities. Manages project budgets and schedules. Develops work plans to address project scope of work. Prepares work plan variances, if necessary. Manages technical project elements.
			Reviews and approves this SAP. Guides the selection of subcontract analytical laboratories. Conducts field and laboratory audits. Serves as a POC for the Navy QAO. Develops corrective action as required. Serves as a technical advisor to the project.
			Develops the project data quality objectives (DQO) and prepares this SAP. Selects qualified subcontract laboratories. Implements chemical data QC procedures and audits field performance. Reviews laboratory data prior to use. Oversees third-party validation of laboratory data. Reviews data validation report. Prepares the appropriate sections of the report summarizing the project sampling activities.
			Oversees overall radiological operations and documentation for the project. Acts as the Technical Lead for radiological data collection. Ensures that the Project Radiological Control Technicians have adequate training in sample collection. Receives and reviews QA laboratory sample data to ensure DQOs are met.
			Develops the project QC objectives and prepares the QC plan. Administers the QC plan. Manages QC documentation and QC deliverables. Lists definable features of work. Conducts inspections (preparatory, initial, follow-up, completions).
			Develops and administers the site safety and health plan. Manages personnel and environmental monitoring. Coordinates preparation of job safety analyses. Selects appropriate personal protective equipment and facilitates daily safety meetings. Reviews essential H&S requirements with on-site personnel.

Name	Title/Role	Organizational Affiliation	Responsibility
			Performs sampling in accordance with approved SAP. Ensures that field QC samples are collected as specified in the SAP. Completes field documentation and implements field corrective actions as required. Must have Occupational Safety and Health Administration (OSHA) 40-hour Certification and 8-hour OSHA Refresher Certification as appropriate.
			Oversees proper analysis and reporting of project samples according to approved SAP. Manages communication between laboratory and APTIM Project Chemist. Ensures proper QA/QC procedures are followed during laboratory analysis.

B.8 SAP Worksheet #8: Special Personnel Training Requirements Table

Field personnel will be required to have completed the OSHA 40-hour Hazardous Waste Operations and Emergency Response Standard Protection training, continued 8-hour Hazardous Waste Operations and Emergency Response, and submit to annual medical surveillance, as required by OSHA. The APTIM SSHO will be responsible for ensuring that training and/or certification is met and that qualified personnel are performing the work.

Project Function	Specialized Training—Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/Organizational Affiliation	Location of Training Records and Certificates
On-Site Project Personnel	Title 49 Transportation Subpart H Function-specific Training	Radiological Controls Supervisor	Prior to start of fieldwork	On-Site Project Personnel	Radiological Controls Supervisor	APTIM Project Files
	Radiation Worker Training (see *Radiation Protection Plan, Basewide Operation, Maintenance, and Radiological Support, Former Hunters Point Naval Shipyard, San Francisco, California* [RPP; APTIM, 2021])	APTIM Project RSO or designee	Prior to start of fieldwork	On-Site Project Personnel	APTIM SSHO	APTIM Project Files

Project Function	Specialized Training—Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/Organizational Affiliation	Location of Training Records and Certificates
Radiological Monitoring Personnel	Site-Specific Qualification	Radiological Controls Supervisor	Prior to start of fieldwork	Junior and Senior Radiological Controls Technicians	Radiological Controls Supervisor	APTIM Project Files

B.9 SAP Worksheet #9: Project Scoping Session Participants Sheet

Project Name: Basewide Operation, Maintenance, and Radiological Support, Hunters Point Naval Shipyard, San Francisco, CA
Projected Date(s) of Sampling: 2021- 2022

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B.10 SAP Worksheet #10: Problem Definition

The project scope includes providing radiological support to HPNS contractors performing non-radiological work in radiologically impacted areas.

B.10.1 Site History and Description

The *Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard* (Navy, 2004) provides information on the historical use of radioactive materials at HPNS.

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B.11 SAP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements

Step 1	**Define the Problem that Necessitates the Study**
Radiologically screen and sample soil, water, debris, and/or stockpiles as applicable under the project scope of work.	
Step 2	**Identify the Goal of the Study**
The goals of the sampling activities are as follows: • Collect radiological soil concentration data • Where soil screening criteria are exceeded, collect sufficient data to delineate elevated areas and/or demonstrate successful removal of elevated soil The study question is as follows: • Do the sampling results support a conclusion that concentrations of project radionuclides of concern meet HPNS criteria for radiological release?	
Step 3	**Identify Information Inputs**
The radiological surveys will include the following: • Gamma scan data and gamma measurements at (biased) locations identified from scan data analysis • Biased soil samples located to characterize the highest gamma scan results Soil samples will be analyzed primarily by gamma spectroscopy (EPA Method 901.1 or equivalent) for cesium-137 (^{137}Cs), radium-226 (^{226}Ra) and daughters, and other gamma emitting radionuclides. Other radionuclide-specific analyses will be performed as noted in subsequent worksheets. Surface soil and subsurface soil analytical data for the applicable radionuclides of concern provided by an accredited off-site laboratory will be used to make project decision. Remediation goals for site-specific radionuclides of concern or the soil areas are shown in Worksheets #15.1 through #15.3. Soil samples will be analyzed for: • Gamma Spectroscopy—EPA Method 901.1 or equivalent • Gas flow proportional counting (GFPC)—EPA Method 905.0 or equivalent • Alpha Spectroscopy—H&S Laboratory A 01 R Building investigation: • Alpha beta static, alpha and beta scan, and alpha beta swipe data collected by radiological survey instruments on buildings and reference area surfaces If a clean backfill soil or rock is needed for site restoration after operation and maintenance activities, APTIM will initially	

look for sources identified under other contracts, if available, this source and applicable analytical data will be submitted for approval for basewide use. If a new backfill source is required, this source will be sampled to determine if it is chemically clean and suitable for use as "clean" fill material following *Information Advisory Clean Imported Fill Material* (DTSC, 2001). Backfill soil will be analyzed for the following parameters:

- Metals by EPA Methods 6020A/7471A
- Volatile organic compounds (VOCs) by EPA Method 8260B
- Semivolatile organic compounds (SVOCs) by EPA Method 8270C
- Polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270C f (SIM)
- Total petroleum hydrocarbons (TPH) as gasoline and diesel/motor oil by EPA Method 8015B
- Polychlorinated biphenyls (PCBs) by EPA Method 8082
- Organochlorine pesticides (OCPs) by EPA Method 8081A
- Asbestos by California Air Resources Board (CARB) 435 (one per source)
- Gamma Spectroscopy by EPA Method 901.1MOD/DOE EML HASL 300 Method GA-01-R
- Strontium-90 (^{90}Sr), GFPC—EPA Method 905.0 or equivalent

Step 4	**Define the Boundaries of the Study**
The boundary of this project are areas throughout HPNS as needed to supporting other non-radiological contractors.	
Step 5	**Develop the Analytic Approach**

Decision rules are described as follows:

- Radiological soil sampling will be performed as specified in the work plan.
- The sampling frequency is designed to provide a high degree of confidence that the project areas are adequately characterized.
- If the results of the survey meet HPNS criteria for radiological release, then the data will be used to support a conclusion that the screened material meets the conditions for unrestricted radiological release.
- If the results of the survey exceed HPNS criteria, then remediation will be performed, and additional biased samples will be collected to verify that as-left soil conditions meet HPNS criteria.
- If analytical results from a potential backfill soil source are below the criteria shown in Worksheet #15, then this source will be considered suitable for backfill.
- If analytical results from a potential backfill soil source are above the criteria shown in Worksheet #15, then this source is not suitable for backfill and another source will be identified.

Step 6	Specify Performance or Acceptance Criteria
To limit uncertainty in the obtained environmental data, criteria for the precision, accuracy, representativeness, completeness, and comparability parameters and Decision Limit Concentrations (DLC) for the contaminants of concern have been developed. Measurement errors will be controlled by using appropriate sampling and analytical methods, and the laboratory errors will be controlled by adhering to the DoD QSM (2019a), following established standard operating procedures (SOPs), and having the Project Chemist performing data review to verify laboratory processes. The field crews will review this SAP before sample collection to limit sample collection errors. The subcontract analytical laboratory will have a copy of this SAP and will adhere to DoD QSM guidance to limit measurement errors. The *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (MARSSIM; U.S. Nuclear Regulatory Commission [NRC] et al., 2000) guidelines will be used and a 95 percent confidence level for detecting radioactivity above the release criterion will be assumed with Type I and II errors limited to 2.5 and 5 percent, respectively.	
Step 7	**Plan the Design for Obtaining Data**
The radiological survey design for this project is based on MARSSIM guidelines (NRC et al., 2000). Specific details regarding types of radiation measurements, instrument detection capabilities, quantities, and locations of data to be collected and investigation levels are discussed in the work plan.	

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B.12 SAP Worksheet #12: Measurement Performance Criteria Table—Field Quality Control Samples (Soil—Backfill Material Only)

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Matrix spikes (MSs)	Not applicable				
Rinse blanks	Not applicable				
Field duplicates	None	Due to known heterogeneity of contaminant distribution in soil matrix, field duplicates for soil will not be collected for this project	Not applicable	Not applicable	S&A
Temperature blanks	Radiochemical analysis	None	Representative-ness	Not applicable to radiochemistry	S
Temperature blanks	Chemical analysis (backfill material)	1 per cooler	Representative-ness	≤ 6°C	S

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B.13 SAP Worksheet #13: Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Existing site radiological data	*Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard*	Navy, 2004	Site characterization	None

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B.14 SAP Worksheet #14: Summary of Project Tasks

B.14.1 Scope of Work

The scope of work of sampling activities for this project includes the following:

- Maintaining HPNS radiological controls and postings
- Performance of radiological surveys and sampling and providing radiological support to other contractors
- Performance of incoming and outgoing radiological surveys as needed
- Operation of the HPNS portal monitor
- Provide dosimetry to non-radiological contractor personnel

B.14.2 Sample Collection Methods and Procedures

Sampling methods and procedures are that will be used to collect samples for this project are provided in Worksheet #21.

B.14.3 Analytical Requirements

Analytical methods will be performed according to the applicable EPA and DoD QSM (2019a) QC requirements (e.g., initial calibrations [ICALs], continuing calibrations, tuning, reagent blanks, surrogates, replicates, and laboratory control sample [LCS]) as described in Worksheets #24 and #28.

B.14.4 Quality Control Tasks

Samples will have appropriate associated QC samples, analyzed as blanks and LCS, as described in Worksheets #12, #20, and #28.

B.14.5 Data Recording and Transfer

This section details the requirements for data reporting and data package formats that will be provided by the laboratory.

B.14.5.1 Hard Copy Deliverables

Relevant raw data and documentation, including (but not limited to) logbooks, data sheets, electronic files, and final reports, will be maintained by the laboratory for at least

10 years. The laboratory will notify APTIM 30 days before disposal of relevant laboratory records.

The hardcopy data deliverable requirements for this project are as follows:

- Radiological characterization samples—90 percent Stage 2B and 10 percent Stage 3
- Wastewater—100 percent Stage 2A

B.14.5.2 Electronic Deliverables

The laboratory EDD will be in Equis format (APTIM database format). The analytical laboratory will follow the requirements stated in the Laboratory Interface Document for the Analytical Laboratory EDD.

The laboratory will certify that the EDD and the hard copy reports are identical. Both the EDD and the hard copy will present results to two or three significant figures. Field information (e.g., date and time collected, sample identification) will be entered directly into the main database from the chain-of-custody (COC) record or uploaded from electronic files generated in the field by the APTIM data manager.

B.14.6 Data Management

This section describes the data management procedures for data review, verification, reporting, and validation.

B.14.6.1 Data Reduction, Verification, and Reporting

Analytical data generated by the laboratory projects will be reviewed prior to reporting to ensure the validity of reported data. This internal laboratory data review process will consist of data reduction, three levels of documented review, and reporting. Review processes will be documented using appropriate checklist forms, or logbooks, that will be signed and dated by the reviewer.

B.14.6.2 Data Reduction

Data reduction involves the mathematical or statistical calculations used by the laboratory to convert raw data to the reported data. The laboratory will perform reduction of analytical data as specified in each of the appropriate analytical methods

and laboratory SOPs. For each method, raw data results will be recorded using method-specific forms or a standardized output from each of the various instruments.

Data calculations will be verified and initialed by personnel both generating and approving them. Raw and electronic data, notebook references, supporting documentation, and correspondence will be assembled, packaged, and stored for a minimum of 10 years for future use. Reports will be held client confidential. If the laboratory is unable to store project-related data for 10 years, then it is the responsibility of the laboratory to contact APTIM to make alternative arrangements.

B.14.6.3 Laboratory Data Verification and Review

The laboratory analyst who generates the analytical data will have the primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that data of known quality are generated consistently. Data generated and reduced will follow well-documented in-house protocols.

B.14.6.3.1 Level 1. Laboratory Technical (Peer) Data Review

Analysts will review the quality of their work based on an established set of guidelines, including the QC criteria established in each method, in this SAP, and as stated within the laboratory DoD QSM (2019a). This review, at a minimum, will ensure that the following conditions have been met:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- Appropriate SOPs have been followed.
- Calculations are verified.
- There are no data transposition errors.
- Analytical results are correct and complete.
- QC samples are within established control limits.
- Blanks and LCS are within appropriate QC limits.
- Special sample preparation and analytical requirements have been met.

Documentation is complete, for example, when anomalies and holding times have been documented, and forms have been completed.

B.14.6.3.2 Level 2. Laboratory Technical Data Review

A supervisor or data review specialist whose function is to provide an independent review of data packages will perform this review. This review will also be conducted according to an established set of guidelines and will be structured to verify the following findings of the Level 1 data review:

- Appropriate laboratory SOPs have been followed.
- Calibration data are scientifically sound, appropriate to the method, and completely documented.
- QC samples are within established guidelines.
- Qualitative identification of contaminants is correct.
- Manual integrations are justified and properly documented.
- Quantitative results and calculations are correct.
- Data are qualified correctly.
- Documentation is complete, for example, anomalies and holding times have been documented, and appropriate forms have been completed.
- Data are ready for incorporation into the final report.
- The data package is complete and complies with contract requirements.

The Level 2 review will be structured so that calibration data and QC sample results are reviewed, and the analytical results from at least 10 percent of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review will be considered complete.

If problems are found with the data package, an additional 10 percent of the sample results will be checked back to the sample preparatory and analytical bench sheets. This cycle will then be repeated either until no errors are found in the checked data set, or until data have been checked. Errors and corrections noted will be documented.

B.14.6.3.3 Level 3. Laboratory Administrative Quality Assurance Data Review

The laboratory QA Manager will review 10 percent of data packages. This review should be similar to the review as provided in Level 2, except that it will provide a total overview of the data package to ensure its consistency and compliance with project requirements. Errors noted will be corrected and documented.

B.14.7 Data Validation

Radiological data collected for waste characterization purposes will not be validated by a third party but will be reviewed by the APTIM Project Chemist at Stage 2A to establish data usability. If radiological data is to be used for other purposes (other than waste characterization), these sample results will be validated by a third-party validation company at Stage 2B. Data validation will be conducted in accordance with Worksheets #34 through #36 and consistent with the following:

- QSM (DoD, 2019a)
- *General Data Validation Guidelines* (DoD, 2019b)
- *Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)* (MARLAP; EPA et al., 2004)
- MARSSIM (NRC et al., 2000)

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B.15 SAP Worksheet #15: Reference Limits and Evaluation Tables

B.15.1 SAP Worksheet #15.1: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Gamma Isotopes)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC[2]	LOD	DL
Americium-241 (^{241}Am)	86954-36-1	pCi/g	NA	NA	NA	NA	NA	NA
Bismuth-212 (^{212}Bi)	14913-49-6	pCi/g	NA	NA	NA	NA	NA	NA
Bismuth-214(^{214}Bi)	14733-03-0	pCi/g	NA	NA	NA	NA	NA	NA
Cesium-137 (^{137}Cs)	10045-97-3	pCi/g	0.113	Release Criteria	0.07	0.07[2]	NA	NA
Cobalt-60 (^{60}Co)	10198-40-0	pCi/g	NA	NA	NA	NA	NA	NA
Europium-152 (^{152}Eu)	14683-23-9	pCi/g	NA	NA	NA	NA	NA	NA
Europium-154 (^{154}Eu)	15585-10-1	pCi/g	NA	NA	NA	NA	NA	NA
Lead-212 (^{212}Pb)	15092-94-1	pCi/g	NA	NA	NA	NA	NA	NA
Lead-214 (^{214}Pb)	15067-28-4	pCi/g	NA	NA	NA	NA	NA	NA
Potassium-40 (^{40}K)	13966-00-2	pCi/g	NA	NA	NA	NA	NA	NA
Protactinium-234 (^{234}Pa)	15100-28-4	pCi/g	NA	NA	NA	NA	NA	NA
Radium-226 (^{226}Ra)	13982-63-3	pCi/g	1.0 above background[1]	Release Criteria	0.2	0.2[2]	NA	NA
Thallium-208 (^{208}Tl)	14913-50-9	pCi/g	NA	NA	NA	NA	NA	NA
Thorium-232 (^{232}Th)	7440-29-1	pCi/g	NA	NA	NA	NA	NA	NA
Thorium-234 (^{234Th})	15065-10-8	pCi/g	NA	NA	NA	NA	NA	NA
Uranium-235 (^{235}U)	15117-96-1	pCi/g	NA	NA	NA	NA	NA	NA

Notes:

[1] ^{226}Ra background for definitive data is 0.861 picocurie per gram (pCi/g) for this project.

[2] DLC at or less than the value listed must be achieved for ^{137}Cs and ^{226}Ra for samples for this project. Project DLCs for radiological analyses are calculated on a sample specific basis and will vary. The values listed indicate a minimum DLC that will be achieved. DLC for other radionuclides analyzed by gamma spectroscopy are not required to be achieved unless specifically requested on the applicable COC.

CAS	Chemical Abstracts Service
DL	detection limit
DLC	decision level concentration
LOD	limit of detection
NA	not applicable

B.15.2 SAP Worksheet #15.2: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Strontium-90)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Strontium-90 (^{90}Sr)	10098-97-2	pCi/g	0.331	Release Criteria	0.06	0.06	NA	NA

Notes:
Project DLCs for radiological analyses are calculated on a sample specific basis and will vary. The value listed is based on current DLC achieved for HPNS soil using this method of analysis.

CAS Chemical Abstracts Service
DL detection limit
DLC decision level concentration
LOD limit of detection
NA not applicable

B.15.3 SAP Worksheet #15.3: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Alpha Isotopes)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Plutonium-239/240 ($^{239/240}Pu$)	10-12-8	pCi/g	2.59	Release Criteria	0.10	0.10	NA	NA

Notes:

CAS	Chemical Abstracts Service
DL	detection limit
DLC	decision level concentration
LOD	limit of detection
NA	not applicable

B.15.4 SAP Worksheet #15.4: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Tritium)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Tritium (Hydrogen-3)	10028-17-8	pCi/g	2.28	Release Criteria	1	1	NA	NA

Notes:

CAS	Chemical Abstracts Service
DL	detection limit
DLC	decision level concentration
LOD	limit of detection
NA	not applicable

B.15.5 SAP Worksheet #15.5: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Americium-241 (^{241}Am)	86954-36-1	pCi/L	15	Release Criteria	15	15	NA	NA
Bismuth-212 (^{212}Bi)	14913-49-6	pCi/L	NA	NA	NA	NA	NA	NA
Bismuth-214(^{214}Bi)	14733-03-0	pCi/L	NA	NA	NA	NA	NA	NA
Cesium-137 (^{137}Cs)	10045-97-3	pCi/L	119	Release Criteria	55	55	NA	NA
Cobalt-60 (^{60}Co)	10198-40-0	pCi/L	100	Release Criteria	100	50	NA	NA
Europium-152 (^{152}Eu)	14683-23-9	pCi/L	60	Release Criteria	60	30	NA	NA
Europium-154 (^{154}Eu)	15585-10-1	pCi/L	200	Release Criteria	200	100	NA	NA
Lead-212 (^{212}Pb)	15092-94-1	pCi/L	NA	NA	NA	NA	NA	NA
Lead-214 (^{214}Pb)	15067-28-4	pCi/L	NA	NA	NA	NA	NA	NA
Potassium-40 (^{40}K)	13966-00-2	pCi/L	NA	NA	NA	NA	NA	NA
Protactinium-234 (^{234}Pa)	15100-28-4	pCi/L	NA	NA	NA	NA	NA	NA
Radium-226 (^{226}Ra)	13982-63-3	pCi/L	5	Release Criteria	2.5	2.5	NA	NA
Thallium-208 (^{208}Tl)	14913-50-9	pCi/L	NA	NA	NA	NA	NA	NA
Thorium-232 (^{232}Th)	7440-29-1	pCi/L	NA	NA	NA	NA	NA	NA
Thorium-234 (^{234Th})	15065-10-8	pCi/L	NA	NA	NA	NA	NA	NA
Uranium-235 (^{235}U)	15117-96-1	pCi/L	NA	NA	NA	NA	NA	NA

Notes:

CAS	Chemical Abstracts Service
DL	detection limit
DLC	decision level concentration
LOD	limit of detection
NA	not applicable
pCi/L	picocurie per liter

B.15.6 SAP Worksheet #15.6: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Strontium-90)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Strontium-90 (^{90}Sr)	10098-97-2	pCi/L	8	Release Criteria	4	4	NA	NA

Notes:

CAS	Chemical Abstracts Service
DL	detection limit
DLC	decision level concentration
LOD	limit of detection
NA	not applicable
pCi/L	picocurie per liter

B.15.7 SAP Worksheet #15.7: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Alpha Isotopes)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Plutonium-239/240 ($^{239/240}Pu$)	10-12-8	pCi/L	15	Release Criteria	7.5	1.0	NA	NA
Thorium-232 (^{232}Th)	7440-29-1	pCi/L	15	Release Criteria	7.5	1.0	NA	NA
Uranium-235/236 (^{235}U)	15117-96-1	pCi/L	30	Release Criteria	15	1.0	NA	NA

Notes:

CAS	Chemical Abstracts Service
DL	detection limit
DLC	decision level concentration
LOD	limit of detection
NA	not applicable
pCi/L	picocurie per liter

B.15.8 SAP Worksheet #15.8: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Tritium)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Tritium (Hydrogen-3)	10028-17-8	pCi/L	20,000	Release Criteria	500	500	NA	NA

Notes:

CAS	Chemical Abstracts Service
DL	detection limit
DLC	decision level concentration
LOD	limit of detection
NA	not applicable
pCi/L	picocurie per liter

B.15.9 SAP Worksheet #15.9: Reference Limits and Evaluation Table—Site Contaminants (Swipe Matrix—Gross Alpha/Gross Beta)

Analyte	CAS Number	Units	Removable Surface Contamination Limit	Removal Surface Contamination Limit Reference	Removable Surface Contamination DLC	Laboratory-Specific		
						DLC	LOD	DL
Gross Alpha	12587-46-1	dpm/100cm^2	20	Site-Specific ROD or Basewide AM if ROD is not available	14	NA	NA	NA
Gross Beta	12587-47-2	dpm/100cm^2	200	Site-Specific ROD or Basewide AM if ROD is not available	84	NA	NA	NA

Notes:
Gamma isotopes associated with ^{226}Ra or other naturally occurring radioactive material (potassium-40 and uranium-235) are reported at the request of Navy even though the release criteria have not been established.

AM action memorandum
CAS Chemical Abstracts Service
DL detection limit
DLC decision level concentration
dpm/100cm^2 disintegrations per minute per 100 square centimeters
LOD limit of detection
LOQ limit of quantitation
NA not applicable
ROD record of decision
RSL regional screening level

B.15.10 SAP Worksheet #15.10—Backfill Material Reference Limits and Evaluation Table—Volatile Organic Compounds

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	2.0	EPA RSL[1]	1	0.005	0.002	0.0013
1,1,1-Trichloroethane	71-55-6	mg/kg	8,100	EPA RSL	100	0.005	0.002	0.0008
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	0.60	EPA RSL	0.5	0.005	0.002	0.0005
1,1,2-Trichloroethane	79-00-5	mg/kg	1.1	EPA RSL	0.5	0.005	0.002	0.0009
1,1-Dichloroethane	75-34-3	mg/kg	3.6	EPA RSL	1	0.005	0.002	0.0009
1,1-Dichloroethene	75-35-4	mg/kg	230	EPA RSL	100	0.005	0.002	0.0006
1,2,3-Trichlorobenzene	87-61-6	mg/kg	63	EPA RSL	1	0.005	0.002	0.0005
1,2,3-Trichloropropane	96-18-4	mg/kg	0.0051	EPA RSL	0.005	0.005	0.002	0.0006
1,2,4-Trichlorobenzene	120-82-1	mg/kg	24	EPA RSL	1	0.005	0.002	0.0005
1,2,4-Trimethylbenzene	95-63-6	mg/kg	58	EPA RSL	50	0.005	0.002	0.0006
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	0.0053	EPA RSL	0.005	0.005	0.002	0.0001
1,2-Dichlorobenzene	95-50-1	mg/kg	1,800	EPA RSL	100	0.005	0.002	0.0005
1,2-Dichloroethane	107-06-2	mg/kg	0.46	EPA RSL	0.2	0.005	0.002	0.0009
1,2-Dichloropropane	78-87-5	mg/kg	1.0	EPA RSL	0.5	0.005	0.002	0.0006
1,3,5-Trimethylbenzene	108-67-8	mg/kg	780	EPA RSL	50	0.005	0.002	0.0006
1,3-Dichloropropane	142-28-9	mg/kg	1,600	EPA RSL	100	0.005	0.002	0.0008
1,4-Dichlorobenzene	106-46-7	mg/kg	2.6	EPA RSL	1	0.005	0.002	0.0005
2-Butanone	78-93-3	mg/kg	27,000	EPA RSL	500	0.010	0.005	0.0014
2-Chlorotoluene	95-49-8	mg/kg	1,600	EPA RSL	100	0.005	0.002	0.0007
2-Hexanone	591-78-6	mg/kg	200	EPA RSL	100	0.010	0.005	0.0013
4-Chlorotoluene	106-43-4	mg/kg	1,600	EPA RSL	80	0.005	0.002	0.0006
4-Methyl-2-pentanone	108-10-1	mg/kg	33,000	EPA RSL	100	0.010	0.005	0.0013
Acetone	67-64-1	mg/kg	61,000	EPA RSL	500	0.010	0.005	0.0033
Benzene	71-43-2	mg/kg	1.2	EPA RSL	0.5	0.005	0.002	0.0009

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Bromobenzene	108-86-1	mg/kg	290	EPA RSL	1	0.005	0.002	0.0005
Bromochloromethane	74-97-5	mg/kg	150	EPA RSL	1	0.005	0.002	0.0009
Bromodichloromethane	75-27-4	mg/kg	0.29	EPA RSL	0.1	0.005	0.001	0.0005
Bromoform	75-25-2	mg/kg	19	EPA RSL	10	0.005	0.002	0.0002
Bromomethane	74-83-9	mg/kg	6.8	EPA RSL	1	0.005	0.002	0.0015
Carbon Disulfide	75-15-0	mg/kg	770	EPA RSL	10	0.005	0.002	0.0009
Carbon Tetrachloride	56-23-5	mg/kg	0.65	EPA RSL	0.10	0.005	0.002	0.0006
Chlorobenzene	108-90-7	mg/kg	280	EPA RSL	10	0.005	0.002	0.0007
Chloroform	67-66-3	mg/kg	0.32	EPA RSL	0.5	0.005	0.002	0.0013
Chloromethane	74-87-3	mg/kg	110	EPA RSL	10	0.005	0.002	0.0013
cis-1,2-Dichloroethene	156-59-2	mg/kg	160	EPA RSL	10	0.005	0.002	0.0009
Dibromochloromethane	124-48-1	mg/kg	8.3	EPA RSL	1	0.005	0.002	0.0005
Dibromomethane	74-95-3	mg/kg	24	EPA RSL	1	0.005	0.002	0.0008
Dichlorodifluoromethane (Freon 12)	75-71-8	mg/kg	87	EPA RSL	10	0.005	0.002	0.0006
Ethyl benzene	100-41-4	mg/kg	5.8	EPA RSL	2	0.005	0.002	0.0007
Ethylene Dibromide	106-93-4	mg/kg	0.036	EPA RSL	0.01	0.005	0.002	0.0007
Hexachlorobutadiene	87-68-3	mg/kg	1.2	EPA RSL	1	0.005	0.002	0.0007
Methyl tertiary butyl ether	1634-04-4	mg/kg	47	EPA RSL	20	0.02	0.002	0.0001
Methylene Chloride	75-09-2	mg/kg	57	EPA RSL	5	0.010	0.002	0.0011
m/p-Xylene	108-38-3	mg/kg	580	EPA RSL	50	0.005	0.004	0.0014
n-Butylbenzene	104-51-8	mg/kg	3,900	EPA RSL	10	0.005	0.002	0.0006
Propyl benzene	103-65-1	mg/kg	3,800	EPA RSL	10	0.005	0.002	0.0007
o-Xylene	95-47-6	mg/kg	650	EPA RSL	50	0.005	0.002	0.0006
Styrene	100-42-5	mg/kg	6,000	EPA RSL	100	0.005	0.002	0.0006
Tetrachloroethene	127-18-4	mg/kg	24	EPA RSL	1	0.005	0.002	0.0006
Toluene	108-88-3	mg/kg	4,900	EPA RSL	100	0.005	0.002	0.0008

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
trans-1,2-Dichloroethene	156-60-5	mg/kg	1,600	EPA RSL	100	0.005	0.002	0.0008
trans-1,3-Dichloropropene	10061-02-6	mg/kg	1.8	EPA RSL	1	0.005	0.002	0.0006
Trichloroethene	79-01-6	mg/kg	0.94	EPA RSL	0.1	0.005	0.002	0.0008
Trichlorofluoromethane	75-69-4	mg/kg	23,000	EPA RSL	10	0.005	0.002	0.0007
Vinyl Chloride	75-01-4	mg/kg	0.059	EPA RSL	0.040	0.005	0.002	0.0009

Notes:
[1] EPA RSL for residential soil, May 2020, applies to compounds with EPA RSL reference.

CAS Chemical Abstracts Service
DL detection limit
LOD limit of detection
LOQ limit of quantitation
mg/kg milligram per kilogram
RSL regional screening level

B.15.11 SAP Worksheet #15.11—Backfill Materials Reference Limits and Evaluation Table—Metals (Soil Matrix)

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Antimony	7440-36-0	mg/kg	31	EPA RSL[1]	10	0.25	0.20	0.07
Arsenic	7440-38-2	mg/kg	11.1	HPAL	10	0.25	0.20	0.09
Barium	7440-39-3	mg/kg	15,000	EPA RSL	50	0.25	0.10	0.05
Beryllium	7440-41-7	mg/kg	160	EPA RSL	10	0.25	0.20	0.06
Cadmium	7440-43-9	mg/kg	71	EPA RSL	10	0.25	0.20	0.10
Chromium	7440-47-3	mg/kg	120,000	EPA RSL	50	0.25	0.20	0.17
Cobalt	7440-48-4	mg/kg	23	EPA RSL	10	0.25	0.20	0.10
Copper	7440-50-8	mg/kg	3100	EPA RSL	50	0.25	0.20	0.16
Lead	7439-92-1	mg/kg	80	HHRA Note 3; Residential Soil Screening Levels[2]	50	0.25	0.20	0.07
Manganese	7439-96-5	mg/kg	1431	HPAL	50	0.25	0.20	0.10
Mercury	7439-97-6	mg/kg	11	EPA RSL	10	0.02	0.01	0.006
Molybdenum	7439-98-7	mg/kg	390	EPA RSL	50	0.25	0.20	0.08
Nickel	7440-02-0	mg/kg	1,500	EPA RSL	50	0.25	0.20	0.15
Selenium	7782-49-2	mg/kg	390	EPA RSL	50	0.50	0.30	0.22
Silver	7440-22-4	mg/kg	390	EPA RSL	50	0.25	0.20	0.04
Thallium	7440-28-0	mg/kg	0.81	HPAL	0.5	0.25	0.13	0.08
Vanadium	7440-62-2	mg/kg	390	EPA RSL	50	0.25	0.20	0.21
Zinc	7440-66-6	mg/kg	23000	EPA RSL	50	2.0	0.20	0.63

Notes:
[1]EPA RSL for residential soil, May 2020, applies to compounds with EPA RSL reference.
[2] *Human and Ecological Risk Office HERO HHRA NOTE NUMBER: 3, DTSC-modified Screening Levels* (DTSC, 2019)

CAS	Chemical Abstracts Service
DL	detection limit
DL	detection limit
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligram per kilogram
HPAL	Hunters Point Ambient Level
RSL	regional screening level

B.15.12 SAP Worksheet #15.12—Backfill Materials Reference Limits and Evaluation Table—Pesticides and Polychlorinated Biphenyls

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Aroclor-1016	12674-11-2	mg/kg	4.1	EPA RSL[1]	2.0	0.012	0.006	0.003
Aroclor-1221	11104-28-2	mg/kg	0.20	EPA RSL	0.1	0.024	0.016	0.008
Aroclor-1232	11141-16-5	mg/kg	0.17	EPA RSL	0.1	0.012	0.008	0.004
Aroclor-1242	53469-21-9	mg/kg	0.23	EPA RSL	0.1	0.012	0.008	0.004
Aroclor-1248	12672-29-6	mg/kg	0.23	EPA RSL	0.1	0.012	0.008	0.004
Aroclor-1254	11097-69-1	mg/kg	0.24	EPA RSL	0.1	0.012	0.006	0.003
Aroclor-1260	11096-82-5	mg/kg	0.24	EPA RSL	0.1	0.012	0.006	0.002
Dichlorodiphenyl dichloroethane	72-54-8	mg/kg	1.9	EPA RSL	0.5	0.0033	0.0003	0.00015
Dichlorodiphenyl dichloroethylene	72-55-9	mg/kg	2.0	EPA RSL	0.5	0.0033	0.0003	0.00010
Dichlorodiphenyl trichloroethane	50-29-3	mg/kg	1.9	EPA RSL	0.5	0.0033	0.0011	0.00034
Aldrin	309-00-2	mg/kg	0.039	EPA RSL	0.015	0.0017	0.0003	0.00009
alpha-hexachloro cyclohexane	319-84-6	mg/kg	0.0019	EPA RSL	0.001	0.0017	0.0003	0.00010
beta-hexachloro cyclohexane	319-85-7	mg/kg	0.30	EPA RSL	0.1	0.0017	0.0003	0.00010
Chlordane (isomers)	57-74-9	mg/kg	1.7	EPA RSL	1	0.0017	0.00027	0.00014
Dieldrin	60-57-1	mg/kg	0.034	EPA RSL	0.01	0.0017	0.0003	0.00009
Endosulfan I	959-98-8	mg/kg	470	EPA RSL	100	0.0017	0.0003	0.00011
Endosulfan II	33213-65-9	mg/kg	470	EPA RSL	100	0.0033	0.0003	0.00012
Endrin	72-20-8	mg/kg	19	EPA RSL	9.0	0.0033	0.0003	0.00021
gamma-hexachloro	58-89-9	mg/kg	0.57	EPA RSL	0.1	0.0017	0.0003	0.00013

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
cyclohexane								
Heptachlor	76-44-8	mg/kg	0.13	EPA RSL	0.1	0.0017	0.0003	0.00012
Heptachlor Epoxide	1024-57-3	mg/kg	0.07	EPA RSL	0.05	0.0017	0.0003	0.00009
Methoxychlor	72-43-5	mg/kg	320	EPA RSL	100	0.017	0.0029	0.0027
Toxaphene	8001-35-2	mg/kg	0.49	EPA RSL	0.2	0.060	0.027	0.0133

Notes:
[1]EPA RSL for residential soil, May 2020, applies to compounds with EPA RSL reference.

CAS Chemical Abstracts Service
DL detection limit
LOD limit of detection
LOQ limit of quantitation
mg/kg milligram per kilogram
RSL regional screening level

B.15.13 SAP Worksheet #15.13—Backfill Materials Reference Limits and Evaluation Table—Semivolatile Organic Compounds

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference[1]	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ[2]	LOD	DL
1,2,4-Trichlorobenzene	120-82-1	mg/kg	24	EPA RSL	10	0.33	0.083	0.022
1,2-Dichlorobenzene	95-50-1	mg/kg	1,800	EPA RSL	100	0.33	0.083	0.022
1,4-Dichlorobenzene	106-46-7	mg/kg	2.6	EPA RSL	1	0.33	0.167	0.042
2,4,5-Trichlorophenol	95-95-4	mg/kg	6,300	EPA RSL	10	0.33	0.033	0.01
2,4,6-Trichlorophenol	88-06-2	mg/kg	49	EPA RSL	10	0.33	0.033	0.014
2,4-Dichlorophenol	120-83-2	mg/kg	190	EPA RSL	10	0.33	0.033	0.013
2,4-Dimethylphenol	105-67-9	mg/kg	1,300	EPA RSL	100	0.33	0.033	0.019
2,4-Dinitrophenol	51-28-5	mg/kg	130	EPA RSL	10	0.670	0.600	0.055
2,4-Dinitrotoluene	121-14-2	mg/kg	1.7	EPA RSL	1	0.33	0.033	0.010
2,6-Dinitrotoluene	606-20-2	mg/kg	0.36	EPA RSL	0.33	0.33	0.083	0.034
2-Chloronaphthalene	91-58-7	mg/kg	4,800	EPA RSL	10	0.33	0.167	0.055
2-Chlorophenol	95-57-8	mg/kg	390	EPA RSL	10	0.33	0.033	0.010
2-Nitroaniline	88-74-4	mg/kg	630	EPA RSL	10	0.670	0.083	0.034
3,3'-Dichlorobenzidine	91-94-1	mg/kg	1.2	EPA RSL	1	0.670	0.167	0.079
4-Chloroaniline	106-47-8	mg/kg	2.7	EPA RSL	1	0.33	0.167	0.042
4-Nitroaniline	100-01-6	mg/kg	27	EPA RSL	10	0.670	0.167	0.042
Benzyl Alcohol	100-51-6	mg/kg	6,300	EPA RSL	100	0.33	0.033	0.016
Bis(2-Chloroethoxy) methane	111-91-1	mg/kg	190	EPA RSL	10	0.33	0.033	0.016
Bis(2-Chloroethyl) Ether[2]	111-44-4	mg/kg	0.23	EPA RSL	0.33	0.33	0.167	0.060
Bis(2-Ethylhexyl) Phthalate	117-81-7	mg/kg	39	EPA RSL	10	0.33	0.033	0.013
Dibenzofuran	132-64-9	mg/kg	73	EPA RSL	10	0.33	0.033	0.010

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference[1]	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ[2]	LOD	DL
Diethyl Phthalate	84-66-2	mg/kg	51,000	EPA RSL	100	0.33	0.033	0.011
Di-N-butyl Phthalate	84-74-2	mg/kg	6,300	EPA RSL	100	0.66	0.033	0.012
Hexachlorobenzene[2]	118-74-1	mg/kg	0.21	EPA RSL	0.33	0.330	0.033	0.012
Hexachlorobutadiene	87-68-3	mg/kg	1.2	EPA RSL	0.33	0.330	0.167	0.061
Hexachloroethane	67-72-1	mg/kg	1.8	EPA RSL	1	0.330	0.167	0.075
Isophorone	78-59-1	mg/kg	570	EPA RSL	100	0.330	0.033	0.011
Nitrobenzene	98-95-3	mg/kg	5.1	EPA RSL	1	0.330	0.083	0.022
N-Nitrosodi-n-propylamine[2]	621-64-7	mg/kg	0.078	EPA RSL	0.33	0.330	0.083	0.033
Pentachlorophenol	87-86-5	mg/kg	1.0	EPA RSL	1.0	0.670	0.300	0.148
Phenol	108-95-2	mg/kg	19,000	EPA RSL	100	0.330	0.033	0.011

Notes:
[1]EPA RSL for residential soil, May 2020, applies to compounds with EPA RSL reference.
[2]LOQ is above the project comparison criterion, LODs are below the comparison criteria. The laboratory will report non-detected analytes to the LOD and detected concentrations to the DL as estimated (J). The compound is not expected to be present in clean backfill material; therefore, no special analytical testing required.

CAS	Chemical Abstracts Service
DL	detection limit
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligram per kilogram
RSL	regional screening level

B.15.14 SAP Worksheet #15.14—Backfill Materials Reference Limits and Evaluation Table—Polycyclic Aromatic Hydrocarbons (Soil Matrix)

Analyte	CAS Number	Units	Screening Level	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Acenaphthene	83-32-9	mg/kg	3,600	EPA RSL[1]	10	0.005	0.002	0.001
Anthracene	120-12-7	mg/kg	18,000	EPA RSL	10	0.005	0.002	0.001
Benz(a)anthracene	56-55-3	mg/kg	1.1	EPA RSL	0.1	0.005	0.002	0.001
Benzo(a)pyrene	50-32-8	mg/kg	0.11	EPA RSL	0.1	0.005	0.002	0.001
Benzo(b)fluoranthene	205-99-2	mg/kg	1.1	EPA RSL	0.1	0.005	0.002	0.001
Benzo(k)fluoranthene	207-08-9	mg/kg	11	EPA RSL	0.1	0.005	0.002	0.001
Chrysene	218-01-9	mg/kg	110	EPA RSL	10	0.005	0.002	0.001
Dibenz(a,h)anthracene	53-70-3	mg/kg	0.11	EPA RSL	0.1	0.005	0.002	0.001
Fluoranthene	206-44-0	mg/kg	2,400	EPA RSL	100	0.005	0.002	0.001
Fluorene	86-73-7	mg/kg	2,400	EPA RSL	100	0.005	0.002	0.001
Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	1.1	EPA RSL	0.1	0.005	0.002	0.001
Naphthalene	91-20-3	mg/kg	3.8	EPA RSL	1	0.005	0.002	0.001
Pyrene	129-00-0	mg/kg	1,800	EPA RSL	10	0.005	0.002	0.001

Notes:
[1]EPA RSL for residential soil, May 2020, applies to compounds with EPA RSL reference.

CAS Chemical Abstracts Service
DL detection limit
LOD limit of detection
LOQ limit of quantitation
mg/kg milligram per kilogram
RSL regional screening level

B.15.15 SAP Worksheet #15.15—Backfill Materials Reference Limits and Evaluation Table—Total Petroleum Hydrocarbons (Soil Matrix)

Analyte	Analyte ID	Units	Project Comparison Criteria	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
TPH-gasoline range organics	NA	mg/kg	3,500 Total TPH (soil and sediment)	HPNS TPH Criteria	100	1	0.5	0.31
TPH-diesel range organics	NA	mg/kg			100	1.0	0.7	0.3
TPH-motor oil range organics	NA	mg/kg			200	5.0	3.2	1.5

Notes:

DL	detection limit
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligram per kilogram
NA	not applicable

B.15.16 SAP Worksheet #15.16—Backfill Materials Reference Limits and Evaluation Table—Asbestos (Soil Matrix)

Analyte	CAS Number	Units	Project Comparison Criteria	Project Comparison Criteria Reference	Project Quantitation Limit Goal	Laboratory-Specific	
						QL	MDL
Asbestos	———	Percent	< 0.25	CARB	0.25	0.25	NA

Notes:

<	less than
CAS	Chemical Abstracts Service
MDL	method detection limit
NA	not applicable
QL	quantitation limit

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B.16 SAP Worksheet #16: Project Schedule/Timeline Table

Activities	Dates	
	Anticipated Date of Initiation	Anticipated Date of Completion
Draft WP preparation	August 2021	September 2021
Navy WP review	September 2021	January 2022
Final WP	January 2022	January 2022
Subcontracting/procurement	August 2021	July 2023
Basewide operation and maintenance	September 2021	July 2023
Basewide environmental protection coordination and support	October 2021	July 2023
Basewide radiological support	October 2021	July 2023
Annual basewide operation and maintenance reports	October 2021	July 2023
Option Year 1	July 2023	July 2024
Option Year 2	July 2024	July 2025
Option Year 3	July 2025	July 2026

Notes:
WP work plan

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B.17 SAP Worksheet #17: Sampling Design and Rationale

Radiological investigation sampling will be based on guidance in the MARSSIM (NRC et al., 2000) using a systematic sampling approach as described in the following subsections and in the work plan.

B.17.1 Waste Soil and Wastewater Sampling

Waste characterization sampling for chemical constituents is not expected as part of this task order. However, if necessary, typical waste profile analysis is discussed in the waste management plan.

Radiological waste characterization samples for soil and water will be collected at a frequency based on professional judgment, project scope of work, and in consultation with Navy. At a minimum, the analysis will include the isotopes of concern for the site from which the waste was generated. The established radiological release criteria are listed in the “Release Criteria Table.” The “Building/Area Assessment, Classification, and Associated Isotopes of Concern Table” lists the isotopes of concern for buildings, sites, or areas at HPNS that have not achieved free release as of September 25, 2017.

Release Criteria Table

Radionuclide	Total Surface Contamination		Soil		Water (pCi/L)[e]
	Equipment or Waste (dpm/100cm^2)[a]	Structures (dpm/100cm^2)[b]	Outdoor Worker (pCi/g)[c]	Residential (pCi/g)[c]	
Americium-241	100	100	5.67	1.36	15
Cesium-137	5,000	5,000	0.113	0.113	119
Cobalt-60	5,000	5,000	0.0602	0.0361	100
Europium-152	5,000	5,000	0.13f	0.13f	60
Europium-154	5,000	5,000	0.23f	0.23f	200
Plutonium-239	100	100	14.0	2.59	15
Radium-226	100	100	1.0g	1.0g	5h
Strontium-90	1,000	1,000	10.8	0.331	8
Thorium-232	1,000	36.5	2.7	1.69	15
Tritium	5,000	5,000	4.23	2.28	20,000
Uranium-235	5,000	488	0.398	0.195	30

Source:
Final Basewide Radiological Removal Action, Action Memorandum—Revision 2006, Hunters Point Shipyard, San Francisco, California (Navy, 2006)

Notes:
[a] These limits are based on *Regulatory Guide 1.86* (U.S. Atomic Energy Commission, 1974). Limits for removable surface activity are 20 percent of these values.
[b] These limits are based on 25 millirem per year, using RESRAD-Building Version 3.3 or "Regulatory Guide 1.86.", whichever is lower.
[c] The DLC is defined as the lowest net response level, in counts, that can be seen with a fixed level of certainty, customarily 95 percent. The DLC is calculated per sample by considering background counts, amount of sample used, and counting time. The laboratory DLC goal will be approximately 25 percent (%) of the release criterion to meet MARLAP (EPA et al., 2004) recommendations for reasons of quantification. DLC may be lowered by increasing sample size or counting time as necessary.
[d] EPA preliminary remediation goals for two future-use scenarios.
[e] Release criteria for water have been derived from *Radionuclides Notice of Data Availability Technical Support Document* (EPA, 2000) by comparing the limits from two criteria and using the most conservative limit.
[f] Based on EPA-decay-corrected preliminary remediation goals for commercial reuse and *Basewide Radiological Removal Action, Action Memorandum, Hunters Point Shipyard, San Francisco, California* (Tetra Tech EM, Inc., 2000 and 2001).
Draft Phase IV Radiation Investigation Report, Hunters Point Shipyard, San Francisco, California
[g] Limit is 1 pCi/g above background, per agreement with EPA.
[h] Limit is for total radium concentration.

dpm/100cm^2	disintegrations per minute per 100 square centimeters
pCi/L	picocuries per liter

Building/Area Assessment, Classification, and Associated Isotopes of Concern Table

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Action	Isotopes of Concern
	Known-Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System		
Parcel B																					
IR-07*				√		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
IR-18*				√		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Drydock 5				√		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Drydock 6				√		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Drydock 7				√		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Parcel C																					
205 and Discharge Channel				√		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
211		√				N	N	N	N	N	M	L	N	N	N	N	N	L	L	Remediation and Final Status Survey	^{137}Cs, ^{226}Ra, ^{232}Th
224			√			N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{90}Sr
253		√				N	N	N	N	N	H	H	N	N	N	N	N	M	M	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr, ^{232}Th
Drydock 2			√			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Drydock 3			√			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Drydock 4			√			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Parcel D																					
383				√		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report	Tritium, ^{226}Ra, ^{90}Sr
Gun Mole Pier			√			L	L	N	N	N	L	N	L	L	N	N	N	L	N	Review Characterization Report	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Mahan Street—NRDL			√			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Parcel E																					
500 Building Series			√			M	H	N	N	N	N	H	L	M	N	N	N	N	H	Scoping Survey	^{241}Am, ^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
510 Site			√			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
510A Site			√			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Scoping Survey	^{137}Cs, ^{90}Sr
517 Site			√			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey	^{60}Co, ^{137}Cs, ^{90}Sr
520 Site		√				M	M	N	N	N	N	M	M	M	N	N	N	N	L	Characterization Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
707/Kennels		√				L	L	N	N	N	L	M	L	L	N	N	N	L	M	Characterization Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
707 B Site				√		L	L	N	N	N	N	N	N	L	N	N	N	N	L	Characterization Survey (as part of 707 Triangle Area)	^{137}Cs, ^{226}Ra, ^{90}Sr
707 C Site				√		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Characterization Survey (as part of 707 Triangle Area)	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Action	Isotopes of Concern
	Known-Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System		
707 Triangle Area		√				L	H	N	N	N	N	H	L	M	N	N	N	N	M	Characterization Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr, ^{235}U
708				√		L	N	N	N	N	L	N	L	N	N	N	N	N	N	Review Final Status Survey Report	^{137}Cs, ^{90}Sr
719 Site				√		L	L	N	N	N	N	N	L	N	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
Shack 79 Site			√			M	L	N	N	N	N	N	L	L	N	N	N	N	N	Final Status Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
Shack 80 Site		√				H	M	N	N	N	N	N	M	L	N	N	N	N	N	Remediation and Final Status Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
Experimental Shielding Range			√			M	L	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report	^{60}Co, ^{137}Cs, ^{226}Ra
IR-01/21, Industrial Landfill		√				H	H	N	N	N	N	N	M	M	N	N	N	N	N	Review Characterization Survey Report, Remediation, and Final Status Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
IR-02, Bay Fill		√				H	H	N	L	N	N	N	M	M	N	L	N	N	N	Characterization Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
IR-03			√			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
Former Salvage Yard			√			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
Shoreline		√				H	M	L	N	N	N	N	M	M	L	N	N	N	N	Characterization Survey	^{137}Cs, ^{226}Ra, ^{90}Sr
Basewide																					
Storm Drain Lines		√				N	L	N	N	N	L	H	N	L	N	N	N	L	M	Scoping/Characterization Surveys of systems associated with NRDL sites or sites associated with radium use	^{137}Cs, ^{226}Ra, ^{90}Sr
Sanitary Lines		√				N	L	N	N	N	L	H	N	L	N	N	N	L	M	Scoping/Characterization Surveys of systems associated with NRDL sites or sites associated with radium use	^{137}Cs, ^{226}Ra, ^{90}Sr
Septic Systems		√				N	M	N	N	N	N	H	N	L	N	N	N	N	M	Scoping/Characterization Surveys of systems associated with NRDL sites or sites associated with radium use	^{137}Cs, ^{226}Ra, ^{90}Sr
Parcel F																					
Underwater Areas			√			N	L	N	N	N	N	N	L	N	N	N	N	N	N	Scoping Surveys in areas of Operation CROSSROADS decontamination activities and site outfall discharges	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr, ^{235}U
Ship Berths				√		L	L	N	N	N	L	N	N	L	N	N	N	L	N	Review Final Status Survey Report for completed berths; Scoping Survey on remainder	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr
Off-Site Facility																					
ICW 418				√		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey	^{137}Cs, ^{226}Ra, ^{90}Sr

Source:
Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard (Navy, 2004)

Notes:
* Received restricted release from the State of California

H High	Evidence of contamination in the media or migration pathway has been identified.
L Low	The potential for contamination in the type of media or migration pathway is remote.
M Moderate	The potential for contamination in the media or migration pathway exists, although the extent has not been fully assessed.
N None	Evidence of contamination in the specific media or migration pathway has not been found, or known contamination has been removed, and surveys indicate that the media or migration pathway meets today's release criteria.

^{60}Co	Cobalt-60
^{232}Th	Thorium-232
^{235}U	Uranium-235
^{239}Pu	Plutonium-239
^{241}Am	Americium-241
NRDL	Naval Radiological Defense Laboratory

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B.17.2 Wastewater

Wastewater is not expected to be generated. If generated, wastewater will be reused if possible. Wastewater will be collected and stored in approved storage containers prior to sampling for reuse or disposal. If disposal becomes necessary, wastewater will either be discharged to the sanitary sewer system under an applicable San Francisco Public Utilities Department wastewater discharge permit or will be transported off site for disposal at an approved facility (waste management plan). Wastewater will be sampled for radiological characterization prior to release from the site. Wastewater will be sampled for site specific radionuclides of concern using the following methods:

- Alpha Spec (Americium-241, Plutonium-239, Thorium-232, Uranium-235) by HASL 300 Method A01R
- GFPC (^{226}Ra) by EPA 903.0
- GFPC (^{90}Sr) by EPA 905.0
- Gamma spectroscopy (^{137}Cs, Cobalt-60, Europium-152, Europium-154) EPA Method 901.1MOD/DOE EML HASL 300 Method GA-01-R

After wastewater is radiologically released, chemical analysis (described in the waste management plan) will be used to further classify the waster for disposal.

B.17.3 Import Borrow Source Soil

If import soil or rock is needed for site restoration tasks, the import borrow material will be sampled prior to use as backfill. The source of off-site imported backfill will be determined during the project based on commercial availability and analytical testing results. Backfill sampling will be compliant with *Information Advisory Clean Imported Fill Material* (DTSC, 2001). DTSC sampling frequency is as follows:

Area of Individual Borrow Area	Sampling Requirements
Up to 2 acres	Minimum of four samples
2 to 4 acres	Minimum of one sample every half acre
4 to 10 acres	Minimum of eight samples
Greater than 10 acres	Minimum of eight locations with four subsamples

Volume of Borrow Area Stockpile	Samples per Volume
Up to 1,000 cubic yards	One sample per 250 cubic yards

Volume of Borrow Area Stockpile	Samples per Volume
1,000 to 5,000 cubic yards	Four samples for first 1,000 cubic yards plus one sample per each additional 500 cubic yards
Greater than 5,000 cubic yards	12 samples for first 5,000 cubic yards plus one sample per each additional 1,000 cubic yards

In general, the fill source area should be located in nonindustrial areas, and not from sites undergoing an environmental cleanup. Nonindustrial sites include those that were previously undeveloped or used solely for residential or agricultural purposes. The source area sampling procedure will depend on the location and state of the borrow soil (i.e., undeveloped land or stockpiles).

Import fill soil samples will be analyzed for the following parameters:

- VOCs—EPA Methods 5035/8260B
- SVOCs—EPA Method 8270C
- PAH—EPA Method 8270C-SIM
- OCPs—EPA Method 8081A
- PCBs—EPA Method 8082A
- TPH-purgeable (as gasoline)—EPA Method 8015B
- TPH-extractable (as diesel and motor oil)—EPA Method 8015B
- California Code of Regulations Title 22 Metals (17)—EPA Methods 6020/7471A
- Asbestos—CARB 435
- Gamma Spectroscopy by EPA Method 901.1
- ^{90}Sr, GFPC—EPA Method 905.0 or equivalent

Only soil or fine materials will be sampled. If imported engineered fill (i.e., crushed rock and aggregate base) is used, the engineered fill will not be sampled for chemical analyses, but fines will be screened for asbestos by CARB Method 435, and total metals (EPA Method 6020/7471A), in accordance with recommendations of the *Information Advisory Clean Imported Fill Material* (DTSC, 2001). Engineered fill will also be sampled for ^{226}Ra and ^{90}Sr to verify that it does not exceed HPNS background limits. If the quarry or source of rock cannot supply the required asbestos or metals screening information, then one sample of gravel or rock fines will be collected from each fill source. Analytical results from the import material will be compared to the criteria listed

in Worksheet #15. If the results are below the criteria, then the material may be used for import. Otherwise, another source will be identified and sampled.

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B.18 SAP Worksheet #18: Sampling Locations and Methods/Standard Operating Procedures Requirements Table

The sample shown in this worksheet represent estimated radiological sample type needed for this project. Additional samples, if necessary, will be documented on COCs and in the field logbook.

Sampling Location	Purpose	Sample ID Number	Matrix	Depth (feet below ground surface)	Analytical Group	Number of Samples	Sampling SOP Reference
Soil	Radiological characterization	ParcelXX-RSY#-01 Through ParcelXX-RSY#-XX (sequential as needed)	Soil	Surface (0 to 6 inches); depends on radiological screening yard pad thickness	Gamma isotopes, ^{90}Sr, alpha isotopes, and/or tritium	As needed	Worksheet #21
Waste soil	Waste characterization	ParcelXX-WS-01 (sequential as needed)	Soil	NA	Gamma isotopes, ^{90}Sr, alpha isotopes, and/or tritium	As needed, up to 25 samples	Worksheet #21
Wastewater	Radiological characterization of investigation-derived wastewater prior to discharge	WW-001 (sequential as needed)	Water	NA	Gamma isotopes, ^{90}Sr, alpha isotopes, and/or tritium	As needed, up to 25 samples	Worksheet #21

Sampling Location	Purpose	Sample ID Number	Matrix	Depth (feet below ground surface)	Analytical Group	Number of Samples	Sampling SOP Reference
Import soil or rock	Import soil or rock (if needed) for site restoration	BS-001 (sequential as needed)	Soil/ Rock	NA	Gamma isotopes ^{90}Sr Metals Asbestos Soil only VOCs SVOC TPH OCP PCB	As needed	Worksheet #21

Notes:
NA not applicable

B.19 SAP Worksheet #19: Analytical Standard Operating Procedures Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/Reference	Sample Volume	Container	Preservation Requirements	Maximum Holding Time
Soil	Gamma Isotopes	EPA 901.1MOD	250 – 400 grams	One 24-ounce poly	None	None
Soil	^{90}Sr	EPA 905.0/EIChrom/^{90}Sr	250 – 400 grams	One 24-ounce poly	None	None
Soil	Alphas Isotopes	HASL A-01-R	250 – 400 grams	One 24-ounce poly	None	None
Soil	Tritium	EPA 906.0	250 – 400 grams	One 24-ounce poly	None	None
Waste-water	Gamma Spec (^{137}Cs, Cobalt-60, Europium-152, Europium-154)	Preparation and Analysis: 901.1	1 L	One 1-L, poly/glass	Nitric acid to pH<2	None
Waste-water	GFPC (^{226}Ra)	Preparation and Analysis: 903.0	1-L	One 1-L, poly/glass	Nitric acid pH<2	None
Waste-water	GFPC (^{90}Sr)	Preparation and Analysis: 905.0	1 L	One 1-L, poly/glass	Nitric acid pH<2	None

Matrix	Analytical Group	Analytical and Preparation Method/Reference	Sample Volume	Container	Preservation Requirements	Maximum Holding Time
Waste-water	Alpha Spec (Americium-241, Plutonium-239, Thorium-232, Uranium-235)	Preparation and Analysis: HASL 300 Method A01R	1 L	One 1-L, poly/glass	Nitric acid pH<2	None
Water	Tritium	EPA 906.0	1 L	One 1-L, poly/glass	Nitric acid pH<2	None
Soil	TPH as diesel and motor oil	Preparation: EPA 3540 Analysis: EPA 8015B	50 grams	4- or 8-ounce glass jar with Teflon™-lined lid or stainless-steel liner	Cool to less than or equal to (≤) 6 degrees Celsius (ºC)	14 days for extraction and 40 days for analysis
Soil	TPH as gasoline	Preparation: EPA 5035 Analysis: EPA 8015B	5 grams	Three EnCore® devices or Three Terra Core™ devices or equivalent	Cool to ≤6 ºC	For EnCore®: Analysis within 48 hours for unpreserved sample or extruded into an empty vial, and freeze (<-7 ºC) or preserve with sodium bisulfate (or other suitable solvent) within 48 hours of sampling With a holding time of 14 days For Terra Core™: Samples extrude immediately upon
Soil	VOCs	Preparation: EPA 5035 Analysis: EPA 8260B	30 grams	Three EnCore® devices or Three Terra Core™ devices or equivalent	Cool to ≤6 ºC	

Matrix	Analytical Group	Analytical and Preparation Method/Reference	Sample Volume	Container	Preservation Requirements	Maximum Holding Time
						collection into pre-weighed field preserved vials with appropriate solvent (methanol, sodium bisulfate) with a holding time of 14 days
Soil	OCPs and PCB	Preparation: 3550B/3540 Analysis: EPA 8081/8082	30 grams	4- or 8-ounce glass jar with Teflon™-lined lid or stainless-steel liner	Cool to ≤6 ºC	14 days to extraction 40 days after extraction
Soil	SVOCs/PAH	Preparation: 3550/3540 Analysis: EPA 8270C/8270C-SIM	30 grams	4- or 8-ounce amber glass jar with Teflon™-lined lid or stainless-steel liner	Cool to ≤6 ºC	14 days to extraction 40 days after extraction
Soil	Metals	Preparation: 3050 Analysis: EPA 6020	2 grams	4- or 8-ounce glass jar with Teflon™-lined lid or stainless-steel liner	Cool to ≤6 ºC	180 days
Soil	Mercury	Preparation and Analysis: EPA 7471A	2 grams	4- or 8-ounce glass jar with Teflon™-lined lid or stainless-steel liner	Cool to ≤6 ºC	28 days
Soil	Asbestos	Preparation and Analysis: CARB Method 435	2 grams	4-ounce glass jar with Teflon™-lined lid or plastic baggie	None	None

Notes:
L liter
mL milliliter

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B.20 SAP Worksheet #20: Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Primary Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equipment Rinse Blanks	No. of Trip Blanks	Total No. of Samples to Laboratory
Soil	Gamma Isotopes ^{90}Sr Alpha Spec	1 (collect as necessary)	None	None	None	None	None	25 (estimated)
Water	Gamma Isotopes ^{90}Sr Alpha Spec	1 (collect as necessary)	None	None	None	None	None	25 (estimated)
Import Soil or Rock	Gamma Isotopes ^{90}Sr VOC SVOC/PAH Metals TPH OCP PCB	As needed	None	None	None	None	None	As needed

Notes:
MSD matrix spike duplicate

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B.21 SAP Worksheet #21: Project Sampling Standard Operating Procedures References Table

B.21.1 Shallow Soil Sampling from Borrow Soil or Radiological Screening Yard Pads

Shallow soil samples will be collected from radiological screening yard pads to screen material for radiological characterization. Soil samples will be collected using a grab sampling technique. Samples will be collected using the following procedure:

1. Obtain a new (unused) disposable sampling scoop (or other nondisposable decontaminated sampling equipment).
2. Put on a new (unused) pair of sampling gloves and other appropriate personal protective equipment.
3. Establish the systematic triangle grid pattern throughout the radiological screening yard pad using a randomly selected starting point.
4. For borrow soil, establish the sampling grid or locations necessary for volume of import needed.
5. Collect the soil samples for analysis into the appropriate sample containers using a disposable sampling scoop. Remove large rocks, sticks or other debris from the sample prior to filling the sample jar.
6. Label, package, and prepare the samples for shipment to the laboratory.
7. Radiologically release sample containers from the radiological areas prior to shipment to the laboratory.

B.21.1.1 Wastewater Sampling

Wastewater samples from on-site storage tanks, if needed, will be collected using a grab sampling technique (disposable bailer, Coliwasa, or equivalent). Samples will be collected using the following procedure:

1. Obtain an unused sampler for each sample event.
2. Put on a new, clean, and chemical-resistant pair of disposable gloves.
3. Lower the sampler into the containment area to the desired depth. Allow sufficient time for the bailer to fill with water.
4. Retrieve the sampler and fill appropriate bottle(s) for analyses being requested.

5. If the storage container is equipped with sampling taps, samples may be collected at these locations.
6. Cap the bottle(s) and wipe moisture from the outside of the bottle(s).
7. Label, package, and prepare the samples for shipment to the laboratory. Transfer the samples to cold storage after collection.

B.21.2 EnCore® or Terra Core™ Soil Sampling for Volatile Organic Compounds

Backfill soil samples for VOCs or TPH-gasoline will be collected using EnCore® sampling devices (or equivalent) following the general procedure described as follows:

1. Obtain EnCore®/Terra Core™ device and T-Handle (or equivalent).
2. Put on a new, clean, and chemical-resistant pair of disposable gloves prior to taking the sample, the Sample Technician will test the plunger for free movement by pushing the plunger rod down until it rests against the tabs.
3. The locking lever on the EnCore® T-Handle must be depressed as the cartridge is inserted. Line up the slots on the cartridge with the locking pins in the T-Handle. Plunger end first, insert cartridge into T-Handle with locking tabs aligned and twist cartridge clockwise locking the cartridge in place.
4. Apply EnCore® or Terra Core™ to freshly exposed surface soil or from one end of a sleeve core as soon as it is brought to the surface. Holding the device with the T-Handle up and the cartridge down, insert the sampling device into the soil. The coring body must be full, be checked to make sure the plunger end is seen in the viewing hole. Withdraw sampling device from soil and wipe of excess dirt from cartridge body.
5. The EnCore® cartridge core is capped while it is still on the T-Handle. Push or twist cap on until the groves are seated over the ridge of the coring body.
6. Remove the capped sampler by pushing down the locking lever on T-Handle and twisting and pulling sampler from T-Handle. The plunger is locked by rotating plunger rod until the wings rest against the tabs. Attach the label and seal the cartridge in the EnCore® sampler bag.
7. The EnCore®sampler holding time is 48 hours. Soil samples are shipped to the laboratory for preservation or freezing within the 48-hour holding time. After preservation, the soil sample can be held up to 14 days for analysis.

8. If using Terra Core™ sampling devices. Transfer the 5-gram soil plug to the appropriate volatile organic analysis vial with preservative (sodium bisulfate, methanol, or water). After preservation, the soil sample can be held up to 14 days for analysis.
9. Label, package, and prepare the samples for shipment to the laboratory. Place the samples in cold storage after collection. Record the sample in the sample collection log and COC. Due to short holding times, if soil samples for VOCs and TPH-g are collected on a Friday, additional coordination with the laboratory is required.

B.21.3 Soil Sampling with a Slide Hammer

Backfill soil samples from borrow sources may also be collected using a hand auger and lined slide hammer or with disposable scoops (Section B.21.1), using whichever technique best suits site conditions. Samples collected with a slide hammer will be fitted with a stainless-steel liner according to the following procedure:

1. Obtain decontaminated stainless sleeves, hand auger, and slide hammer.
2. Put on a new, clean, and chemical-resistant pair of disposable gloves.
3. Auger to the desired sampling depth. Use slide hammer with clean sleeve to collect sample.
4. Fill the sample sleeve completely with soil.
5. Collect samples for VOCs and/or TPH-purgeable (if required) from the liner with an airtight sampling device (EnCore® or equivalent, Section B.21.2).
6. Cover both ends of sleeves with Teflon® sheets and plastic caps.
7. Label, package, and prepare the samples for shipment to the laboratory. Place the samples in cold storage after collection. Record the sample in the sample collection log and COC.

B.21.4 Equipment Decontamination

Sampling equipment decontamination is not anticipated for this project since disposable equipment will be used as much as possible. However, if decontamination is necessary, the following procedures will be used. Decontamination of nondisposable sampling equipment that comes in contact with samples (i.e., sleeve rings and the split-spoon sampling device) will be performed to prevent the introduction of extraneous material into samples, and to prevent cross-contamination between samples. If required,

sampling equipment will be decontaminated by steam cleaning, or by washing with a nonphosphate detergent such as Liquinox™ or equivalent. Decontamination water will be collected in 55-gallon U.S. Department of Transportation-approved drums or a poly-tank.

The following procedures will be used for decontamination of nondisposable sampling equipment:

1. If mud or soil is adhering to the sampling equipment, first rinse with potable water. This step will decrease the gross contamination and reduce the frequency at which the nonphosphate detergent and water solution need to be changed.
2. Wash with the nonphosphate detergent and water solution. This step will remove remaining contamination from the equipment. Dilute the nonphosphate detergent as directed by the manufacturer.
3. Rinse with potable water. Change the water frequently.
4. Rinse with deionized water. This step will rinse detergent solution and potable water residues. Rinsing will be done by applying the deionized water from a clean squeeze bottle (or equivalent) while holding equipment over a bucket.

B.22 SAP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
No field instruments for chemical screening will be used for this project.						
Radiological controls portable instrument procedures are described in detail in the RPP (APTIM, 2021) and work instructions					Project RSO or designee	APTIM, in progress

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B.23 SAP Worksheet #23: Analytical Standard Operating Procedures References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance from DoD QSM? (Y/N)
DV-GC-0010	Gasoline Range Organics (GRO) by GC/FID [SW846 Method 8015 and State Methods] 2/22/21	Definitive	Soil/Water	Gas chromatography/flame ionization detector	Eurofins Test America Denver Laboratory	N
DV-GC-0020	Chlorinated pesticides [EPA 8081A& 8081B] 5/14/21	Definitive	Soil/Water	Gas chromatography/electron capture detector	Eurofins Test America Denver Laboratory	N
DV-GC-0021	PCBs by GC-ECD; [SW846 Methods 8082 and 8082A]; 5/19/21	Definitive	Soil/Water	Gas chromatography/electron capture detector	Eurofins Test America Denver Laboratory	N
DV-GC-0027	Diesel and Residual Range Organics (DRO and RRO) by GC/FID, 4/9/21	Definitive	Soil	Gas chromatography/flame ionization detector	Eurofins Test America Denver Laboratory	N
DV-MS-0002	Polynuclear Aromatic Hydrocarbons (PAH) GC/MS Selected Ion Monitoring (SIM) [SW846 Method 8270C/D/E] 5/21/21	Definitive	Soil	Gas chromatography/mass spectrometry	Eurofins Test America Denver Laboratory	N
DV-MS-0010	Determination of Volatile Organic Compounds by GC/MS; 5/21/21	Definitive	Soil/Water	Gas chromatography/mass spectrometry	Eurofins Test America Denver Laboratory	N
DV-MS-0011	GC/MS Analysis Based on Methods 8270C and 625/625.1;6/7/21	Definitive	Soil/Water	Gas chromatography/mass spectrometry	Eurofins Test America Denver Laboratory	N
DV-MT-0016	Mercury in Solids by Cold Vapor Atomic Absorption; 6/11/21	Definitive	Soil	Cold vapor atomic adsorption	Eurofins Test America Denver Laboratory	N
DV-MT-0022	ICP Mass Spectrometry for Trace Element Analysis by SW-846 Method 6020A/B,8/19/21	Definitive	Soil/Water	Inductively coupled plasma/mass spectrometry	Eurofins Test America Denver Laboratory	N
ST-RC-0003	Drying and Grinding of Soil and Solid Samples for Radiochemistry Analysis 7/6/21	Definitive	Soil	NA	Eurofins Test America St. Louis	N
ST-RC-0025	Preparation of Samples for Gamma Spectroscopy, 4/14/21	Definitive	Soil	Gamma spectrometer	Eurofins Test America St. Louis	N
ST-RC-0050	Aqueous and Soil Sample Preparation for Strontium-89, Strontium-90 and Total Strontium, 2/18/21	Definitive	Soil	GFPC	Eurofins Test America St. Louis	N
ST-RC-0058	Sample Preparation for Strontium-89, Strontium-90 and Total Strontium Using Extraction Chromatography 3/31/2021	Sample Preparation Definitive	Soil	Sample preparation for GFPC	Eurofins Test America St. Louis	N
ST-RC-0100	Actinide Coprecipitation, 3/3/21	Definitive	Soil/Water	Alpha spectrometer	Eurofins Test America St. Louis	N
ST-RC-0240	Isotopic Americium, curium, plutonium, thorium, and uranium in various matrices by Eichrom Separation Resin, 12/23/20	Definitive	Soil/Water	Alpha spectrometer	Eurofins Test America St. Louis	N
ST-RC-0301	Radium Isotopes by Alpha Spectrometry, 12/31/20	Definitive	Soil/Water	Alpha spectrometer	Eurofins Test America St. Louis	N
ST-RD-0102	Gammavision® Analysis, 10/30/20	Definitive	Solids Gamma Isotopes (^{226}Ra and ^{137}Cs)	Gamma spectrometer	Eurofins Test America St. Louis	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance from DoD QSM? (Y/N)
ST-RD-0210	Alpha Spectroscopy Analysis, 9/30/20	Definitive	Soil/Water	Alpha spectrometer	Eurofins Test America St. Louis	N
ST-RD-0403	Low Background Gas Flow Proportional Counting System Analysis, 7/19/21	Definitive	Solids, ^{90}Sr	GFPC	Eurofins Test America St. Louis	N
33.308.8	Determination of Asbestos Content of Serpentine Aggregate by Polarized Light Microscopy and Point Counting; 8/20/2020	Definitive	Asbestos in soil	Polarized light microscopy	NVL Laboratory	N

Notes:
SOPs provided in Attachment B-2.

NA not applicable

B.24 SAP Worksheet #24: Analytical Instrument Calibration Tables

B.24.1 SAP Worksheet #24.1: Analytical Instrument Calibration Table (Gamma Spectrometry)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
Gamma Spectrometry	ICAL	Prior to initial use, following repair or loss of control and upon incorporation of new or changed instrument settings (MARLAP 18.5.6.2; EPA et al., 2004)	Verify manufacturer's specifications for gamma peak resolution (MARLAP 18.5.6.2) Efficiency vs. energy for each geometry/matrix 95% confidence limit of the fitted function: ≤ 8% over energy range (MARLAP 18.5.6.2) or peak energy difference is within 0.1 kiloelectron volt (keV) of reference energy for points Peak full width at half maximum (FWHM) < 2.5 keV at 1332 keV Energy vs. channel slope equation will be linear and accurate to 0.5 keV	Correct problem, then repeat ICAL	Laboratory Manager/Analyst	ST-RD-0102
	ICAL verification (ICV)	After ICAL for energy/efficiency and prior to analysis of samples	Observed peaks of second-source standard fall within plus or minus (±) 10% of ICAL value relative to energy, FWHM, and efficiency	Verify second-source standard and repeat ICV to check for errors If that fails, identify and correct problem and repeat ICV or ICAL and ICV as appropriate		
	Continuing calibration verification (CCV) (Daily Check)	Daily or prior to use When working with long count times or batch sequences that run more than a day, CCV is performed at the beginning and end of each analytical batch as long as it no longer than a week	Verify peak shift within tolerance limit; verify efficiency within control parameters; verify resolution in tolerance limit Response checks will have a tolerance limit or control chart set at ± 3% or 3σ of the mean (MARLAP 18.5.6.2); or peak Energy/Efficiency: low, mid, and high energies within 10% of the ICAL value; FWHM: low, mid, and high energies within 10% of initial FWHM value	Correct problem, rerun CCV If that fails, then repeat ICAL Reanalyze samples since the last successful calibration verification		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
	Background subtraction count (BSC) measurement (long count for subtracting background from blanks or test sources)	Immediately after ICAL and then performed on at least a monthly basis (MARLAP 18.5.6.2)	Statistical test of successive counts and count rates for identified background peaks show no significant difference (MARLAP 18.5.6.2)	Recount and check control chart for trends Determine cause, correct problem, re-establish BSC If background activity has changed, re-establish BSC and reanalyze or qualify impacted samples since last acceptable BSC		

B.24.2 SAP Worksheet #24.2: Analytical Instrument Calibration Table (Alpha Spectrometry)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
Alpha Spectrometry	ICAL	Prior to initial use, following repair or loss of control and upon incorporation of new or changed instrument settings (MARLAP 18.5.6.2; EPA et al., 2004)	Verify manufacturer's specifications for source efficiency (MARLAP); and two calibration peaks that are: 1) greater than or equal to (≥)700 keV apart; or 2) that bracket peaks to be determined Energy vs. channel slope equation <15 keV per channel Full Width –Half Maximum (FWHM) <100 keV for each peak used for calibration Minimum of 3,000 net counts in each peak	Correct problem, then repeat ICAL	Laboratory Manager/Analyst	ST-RD-0210
	ICV	After ICAL	Determine peak location, resolution, and radionuclide of interest/alpha peak efficiency (where counting efficiency is an analytical requirement) using at least two alpha peaks (MARLAP 18.5.6.3) Or Observed peak centroid falls within ±20 keV from reference energyfor each peak used in the initial energy calibration FWHM ≤100 keV and within ±20 keV of corresponding calibration peaks in initial energy calibration	Repeat ICV to check for error If that fails, identify and correct problem and repeat ICV or ICAL and ICV, as appropriate		
	CCV (Pulsar Check)	Pulsar energy verification weekly, prior to analysis of samples Use either pulsar check or check source	Energy response check will have a tolerance limit set at ± 3% or control chart set at ± 3σ (MARLAP 18.5.6.3) or observed peak centroid falls ≤20 keV from reference energy	Recount and check control chart for trends Determine cause, correct problem, and repeat CCV and associated samples since last successful CCV		
	CCV (Check Source)	Weekly source check verification prior to analysis of samples Use either pulsar check or	Response checks will have a tolerance limit or control chart set at ± 3% or 3σ (MARLAP 18.5.6.3) or observed peak	Recount and check control chart for trends Determine cause, correct problem, and repeat CCV and		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
		check source	centroid falls within 20 keV from reference energy for each peak used in the initial energy calibration FWHM ≤100 keV and within 30 keV of corresponding calibration peaks in initial energy calibration	associated samples since last successful CCV		
	BSC	Prior to initial use or after ICAL and monthly (MARLAP 18.5.6.3)	Within ±3σ of mean activity of recent BSCs for total radionuclide of interest for isotopes of interest (minimum of three BSC values)	Recount and check control chart for trends Determine cause, correct problem, re-establish BSC If background activity has changed, re-establish BSC and reanalyze or qualify impacted samples since last acceptable BSC		

B.24.3 SAP Worksheet #24.3: Analytical Instrument Calibration—Chemical Analyses

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Actions	SOP Reference[1]
Gas Chromatography/Mass Spectrometry Volatile and Semivolatile Organic Analyte	Check of mass spectral ion intensities (tuning procedure EPA Method 8260 and 8270)	Prior to ICAL and prior to each 12-hour period of sample analysis	Must meet the EPA Method tune requirements specific ion abundance criteria of bromofluorobenzene or decafluorotriphenyl-phosphine before samples are analyzed	If necessary, perform maintenance, retune instrument, and verify the tune acceptability	Analyst/Supervisor	Worksheet #23
	ICAL: Minimum five levels for linear and six levels for quadratic	ICAL prior to sample analysis	Each analyte must meet one of the following: Option 1: relative standard deviation for each analyte ≤15% Option 2: linear least squares regression correlation r2 ≥ 0.99 Option 3: nonlinear least squares regression (quadratic) for each analyte: r2≥0.99	If necessary, perform maintenance and Retune instrument repeat ICAL		
	Second-source ICV	Once after each ICAL	Analytes within ±20% of true value	Correct problem and rerun ICV If that fails, repeat ICAL		
	Retention time (RT) window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical sequence	Position will be set using the midpoint standard of the ICAL curve when ICAL is performed On days when ICAL is not performed, the initial CCV is used	Not applicable		
	Evaluation of relative RT	With each sample	Relative RT of each target analyte within ±0.06 relative RT units	Determine problem, then rerun ICAL		
	CCV	Daily before sample analysis; after every 12 hours of analysis time and at the end of the analytical batch run	Reported analytes and surrogates within ±20% of true value Reported analytes and surrogates within ±50% for end of analytical batch CCV	Recalibrate, and reanalyze affected samples since the last acceptable CCV; or immediately analyze two additional consecutive CCVs If both pass, samples may be reported without reanalysis If either fails, take corrective action(s) and recalibrate; then reanalyze affected samples since the last acceptable CCV		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Actions	SOP Reference[1]
	Performance Check (EPA Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤20% for Dichlorodiphenyl trichloroethane. Benzidine and pentachlorophenol will be present at their normal responses, and will not exceed a tailing factor of 2	Correct problem, then repeat performance checks		
	Internal standards (ISs) verification	Every field sample, standard, and QC sample	RT ±10 seconds from RT of the midpoint standard in the ICAL; Extracted Ion Current Profile area within -50% to +100% of ICAL midpoint standard	Inspect detector and Gas Chromatography for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory		
Inductively Coupled Plasma/Mass Spectrometry	Linear Dynamic Range or High-Level Check Standard	At initial set-up and checked every 6 months with a high standard at the upper limit of the range	Within ± 10% of true value.	Dilute samples within the calibration range or re-establish/verify the Linear Dynamic Range.		
	Tuning	Prior to ICAL.	Mass calibration ≤0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height	Correct problem and repeat tune		
	ICAL for Analytes	Daily ICAL prior to sample analysis	If more than one calibration standard is used, r2 ≥ 0.99	Correct problem and repeat ICAL		
	ICV	Once after each ICAL, analysis of a second-source standard prior to sample analysis.	Reported analytes within ± 10% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL		
	CCV	After every 10 field samples and at the end of the analysis sequence	Reported analytes within ± 10% of the true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze associated samples since the last acceptable CCV.		
	Low-Level Calibration Check Standard	Daily. Low-Level Calibration Check Standard should be ≤to the LOQ.	Reported analytes within ± 20% of the true value	Correct problem and repeat ICAL		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Actions	SOP Reference[1]
	Internal standard	Every field sample, standard and QC sample.	IS intensity in the samples within 30-120% of intensity of the IS in the ICAL blank.	If recoveries are acceptable for QC samples, but not field samples, the field samples may be considered to suffer from a matrix effect. Reanalyze sample at 5-fold dilutions until criteria is met. For failed QC samples, correct problem and rerun associated failed field samples.		
Cold Vapor	ICAL Minimum five standards and calibration blank	Daily ICAL prior to sample analysis	If more than one calibration standard is used, r2≥0.99	Correct problem, then repeat ICAL		
	Second-source ICV	Once after each ICAL, prior to beginning a sample run	Analyte(s) within ±10% of true value	Correct problem Rerun ICV If that fails, rerun ICAL		
	CCV	After every 10 field samples and at the end of the analysis sequence	Within ±10% of true value	Recalibrate, and reanalyze affected samples since the last acceptable CCV; or immediately analyze two additional consecutive CCVs If both pass, samples may be reported without reanalysis If either fails, take corrective action(s) and recalibrate; then reanalyze affected samples since the last acceptable CCV		
	Initial and continuing calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence	No analytes detected greater than (>) LOD	Correct problem and repeat ICAL Samples following the last acceptable calibration blank must be reanalyzed		
Gas Chromatography/Flame Ionization Detector or Gas Chromatography/ Electron Capture Detector	Minimum five-point ICAL for analytes	ICAL prior to sample analysis	One of the options below: Option 1: relative standard deviation for each analyte ≤20% Option 2: linear least squares regression: r2≥0.995 Option 3: nonlinear regression: coefficient of determination r^2 ≥0.99 (six points will be used for second order; seven points will be used for third order)	Correct the problem; then repeat ICAL.	Analyst/Supervisor	Worksheet #23

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Actions	SOP Reference[1]
	Endirn/Dichlorodi-phenyl trichloroethane breakdown check (8081 only)	Before sample analysis and at the beginning of each 12-hour shift	Degradation of Dichlorodiphenyl trichloroethane and Endrin must each be ≤15%	Correct the problem; then repeat breakdown check		
	ICV	Once after each ICAL, analysis of a second-source standard prior to sample analysis	Project analytes within established RT windows Gas Chromatography methods: project analytes within ±20% of expected value from the ICAL	If necessary: Perform instrument maintenance, then repeat ICV. If that fails, repeat ICAL.		
	RT window position establishment for each analyte and surrogate.	Once per ICAL and at the beginning of the analytical sequence	Position will be set using the midpoint standard of the ICAL curve when ICAL is performed On days when ICAL is not performed, the initial CCV is used	Perform instrument maintenance if necessary; adjust windows, then re-evaluate analyte identification		
	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence with the exception of CCVs for pesticides multi-component analytes (i.e. toxaphene, chlordane), which are only required before sample analysis	Project analytes within established RT windows Project analytes within ±20% of expected value from the ICAL	Determine the source of the problem and correct, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze samples since the last successful calibration verification.		
Phase Contrast Microscope	Alignment of Optical Components—Use of telescoping eyepiece to verify optical alignment of phase rings.	Daily or prior to analyzing samples	In accordance with unit model and manufacturer's recommendation or laboratory SOP. Ensure phase rings are concentric with each other.	Terminate analysis, recalibrate, and verify before analyzing samples	Laboratory QA officer	Worksheet #23
Polarized Light Microscope	Alignment of Optical Components – Use Anthophyllite fibers mounted in 1.605 Refractive Index Liquid to verify extinction angle of these fibers be parallel to either X or Y axis.	Daily or prior to analyzing samples	In accordance with unit model and manufacturer's recommendation or laboratory SOP. Extinction of Anthophyllite fiber must be observed parallel to either X or Y axis with polarizer and analyzer at a 90-degree angle.	Terminate analysis, recalibrate, and verify before analyzing samples	Laboratory QA officer	Worksheet #23

B.25 SAP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Gamma Spectroscopy	Efficiency check	CCV Count	Multipoint	Daily	±3% or 3σ of the mean	Recount	Analyst/Department Manager	Worksheet #23
Gamma Spectrometer	1. Clean cave; fill dewar with nitrogen 2. QA check	1. Physical check 2. Background and source check	1. Physical check 2. Check deviation	1. Weekly 2. Daily	1. Acceptable background 2. Within 2 σ of measured population	Recalibrate Instrument maintenance Consult with Technical Director	Analyst/Department Manager	Worksheet #23
Gas Chromatography	Injection port maintenance	Preventative maintenance	Change septum, clean injection port, clip column	Daily	CCV passes criteria (Worksheet #24)	Re-inspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst/Department Manager	Worksheet #23
	Trap	CCV response dropping, sample foamed over	Change trap	When responses start to drop or after foam over samples	CCV passes criteria	Re-bake trap, replace trap, reanalyze CCV, recalibrate	Analyst/Department Manager	
Gas Chromatography/ Mass Spectrometry	Injection port maintenance	Preventative maintenance	Change septum, clean injection port, clip column	Daily	Tune and CCV pass criteria	Re-inspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst/Department Manager	Worksheet #23
	Trap	CCV response dropping, sample foamed over	Change trap	When responses start to drop or after foam over samples	Tune and CCV passes criteria	Re-bake trap, replace trap, reanalyze CCV, recalibrate	Analyst/Department Manager	
	Detector maintenance	Column change, unable to tune instrument	Clean detector, change pump oil	When responses drop and tunes start to fail	Tune passes, air and water are not present in the scan	Disassemble detector and check parts, check heating element, reanalyze tune	Analyst/Department Manager	
Inductively Coupled Plasma/Mass Spectrometry	Injector Maintenance	Preventative maintenance	Change injector and torch	Daily to every other day	Intensity of 1 part per million manganese standard within criteria	Replace, investigate injector, reanalyze	Analyst/Department Manager	Worksheet #23
	Pump maintenance	Preventative maintenance	Replace pump windings	Daily	Monitor IS counts for variation	Replace windings, recalibrate and reanalyze	Analyst/Department Manager	

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Polarized Light Microscope	Check microscope alignments	Physical check	Physical check	Daily	Microscope aligned using Anthophyllite fibers mounted in 1.605 refractive index liquid to ensure proper alignment of polarizer and analyzer. The polarizer and analyzer must be set at a 90-degree to one another	Instrument maintenance Consult with Technical Director	Analyst/Department Manager	Worksheet #23

B.26 SAP Worksheet #26: Sample Handling System

Sample Collection, Packaging, And Shipment
Sample Collection (Personnel/Organization): APTIM—Field Technician
Sample Packaging (Personnel/Organization): APTIM—Field Technician
Coordination of Shipment (Personnel/Organization): APTIM—Field Technician
Type of Shipment/Carrier: Laboratory Courier—UPS or FedEx
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): TestAmerica (Sample Receiving)
Sample Custody and Storage (Personnel/Organization): TestAmerica (Sample Receiving)
Sample Preparation (Personnel/Organization): Subcontract Laboratory—TestAmerica Analytical Chemist
Sample Determinative Analysis (Personnel/Organization): Subcontract Laboratory—TestAmerica Analytical Chemist
Sample Archiving
Field Sample Storage (No. of days from sample collection): Shipped to laboratory the same day as collection if possible, if not possible to ship the same day; storage on site in refrigerator or ice-packed cooler in locked building
Laboratory Sample Storage (No. of days from sample collection): Minimum three months TestAmerica
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 30 days—TestAmerica
Biological Sample Storage (No. of days from sample collection): Not applicable to this project
Sample Disposal
Personnel/Organization: TestAmerica
Number of Days from Analysis: Three months

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B.27 SAP Worksheet #27: Sample Custody Requirements Table

B.27.1 Sample Custody and Documentation

Sampling information will be recorded on a COC and in a permanently bound field logbook. Entries will be legible and recorded in indelible ink.

B.27.2 Sample Labeling

Sample labels will be filled out with indelible ink and affixed to each sample container. Non-waterproof sample labels will be covered with clear tape. Sample containers will be placed in resealable plastic bags to protect the sample from moisture during transportation to the laboratory.

Each sample container will be labeled with the following, at a minimum:

- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock)
- Project number
- Sampler's initials
- Analyses to be performed
- Preservation (if any)
- Location (i.e., site name)

B.27.3 Chain-of-Custody

An example COC is shown in Attachment B-1. In addition to providing a custody exchange record for the samples, the COC serves as a formal request for sample analyses. The COC will be completed, signed, and distributed as follows:

- One copy retained by the sample coordinator for inclusion in the project files
- Original sent to the analytical laboratory with the sample shipment

After the laboratory receives the samples, the Sample Custodian will inventory each shipment before signing for it and note on the original COC discrepancy in the number of samples, temperature of the cooler, or broken samples. The Project Chemist will be

notified immediately of problems identified with shipped samples. The Project Chemist will in turn notify the Project QC Manager, and together they will determine the appropriate course of action. The Project Chemist will also notify the PM if the project budget and schedule may be impacted.

The laboratory will initiate an internal COC that will track the sample within the various areas of the laboratory. The relinquishing signature of the Sample Custodian and the custody acceptance signature of the laboratory personnel transfer custody of the sample. This procedure is followed each time a sample changes hands. The laboratory will archive the samples and maintain their custody as required by the contract, or until further notification from the Project Chemist, at which time the samples will either be returned to the project for disposal or disposed by the laboratory.

B.27.4 Sample Packing and Shipment

After sample collection, sample labels will be affixed to each sample container. Each sample will be placed in a resealable plastic bag to keep the sample container and the label dry. Glass sample containers will be protected with bubble wrap (or other cushioning material) to prevent breakage. A temperature blank will be placed in every cooler with samples.

Sample containers from radiological areas will be screened in the field prior to shipping to the laboratory following Work Instruction WI-40113 of the RPP (APTIM, 2021). The field exposure rate collected on the sample container is entered on the COC. Samples to be shipped by commercial carrier will be packed in a sample cooler lined with a plastic bag. Sample cooler drain spouts will be taped from the inside and outside of the cooler to prevent leakage. Saturday deliveries will be coordinated with the laboratory.

If samples are picked up by a laboratory courier service, the COC will be completed and signed by the laboratory courier. The cooler will then be released to the courier for transportation to the laboratory.

If a commercial carrier is used, the COC will include the air bill number in the “Transfers Accepted By” column and will be sealed in a resealable bag. The COC will then be taped to the inside of the sample cooler lid. The cooler will be taped shut with strapping tape, and two custody seals will be taped across the cooler lid. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The samples will then be shipped to the analytical laboratory. A copy of the courier air bill will be retained for documentation.

The shipping of samples to the analytical laboratory by land delivery services will be performed according to the U.S. Department of Transportation regulations. The International Air Transportation Association regulations will be adhered to when shipping samples by air courier services. Transportation methods will be selected to ensure that the samples arrive at the laboratory in time to permit testing according to established holding times and project schedules. No samples will be accepted by the receiving laboratory without a properly prepared COC and properly labeled and sealed shipping container(s).

B.27.5 Field Logbooks

A permanently bound field logbook with consecutively numbered pages will be assigned to this project. A sample collection log work sheet is provided in Attachment B-1. Entries will be recorded in indelible ink. Corrections will be made following the procedure described in Section B.27.6. At the end of each workday, the responsible sampler will sign the logbook pages, and unused portions of a logbook page will be crossed-out, signed, and dated.

At a minimum, the logbook will contain the following information:

- Project name and location (on the front page of the logbook)
- Date and time of collection for each sample (in the upper right corner of each page)
- Sample number
- Sample location (i.e., soil boring or sampling point)
- Sample type (i.e., soil and water)
- Composite or grab
- Composite type (the number of grab samples)
- Depth of sample
- Weather information (e.g., rain, sunny, approximate temperature)
- Containers used and requested analyses

In the graph paper portion of the field logbook, the sampler will fill in the following information:

- A map with sample locations (drawn or paste copy). Each sample location must be clearly identified on the map. Several sample locations may be presented on one map; however, the page with the map must be referred on each of the individual sample pages.
- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments.
- Descriptions of deviations from this SAP.
- Problems encountered and corrective action taken.
- Identification of field QC samples.
- List of QC activities.
- Verbal or written instructions from the Navy and APTIM Project QC Manager.

The sampler will cross-out the unused portion and sign each page.

B.27.6 Document Corrections

Changes or corrections on project documentation will be made by crossing-out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible beneath the cross-out. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly with indelible ink.

B.28 SAP Worksheet #28: Laboratory Quality Control Samples Tables

B.28.1 SAP Worksheet #28.1: Laboratory Quality Control Samples Table (Gamma Isotopes)

Matrix: Soil						
Gamma Radionuclides						
EPA 901.1M/SOP ST-RD-0102						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
Method Blank (MB)	One per preparatory batch (MARLAP 18.4.1; EPA et al., 2004)	|ZBlank |≤3 Investigate recurrent results with |ZBlank |≥2 (MARLAP 18.4.1) Or In-house control limits No analytes detected > target detection limit (DL)	Recount the blank to confirm results, unless sample results are > five times the blank activity Inspect MB control chart for indication of significant bias If required, re-prep and reanalyze MB and samples processed with the contaminated blank	Laboratory Manager/Analyst	A means of assessing the existence and magnitude of contamination introduced via the analytical process	|ZBlank |≤3 No analytes detected > decision limits or blank results can not affect project decisions
LCS	One per analytical batch	|ZLCS|≤3 Investigate recurrent results with |ZLCS|≥2 (MARLAP 18.4.2) In-house control limits may not fall more than ±25% from the known LCS value	Recount the LCS to confirm results Inspect LCS control chart for indication of significant bias If required, re-prep and reanalyze the LCS and associated samples	Laboratory Manager/Analyst	Accuracy	|ZLCS|≤3 Investigate recurrent results with |ZLCS|≥2 (MARLAP 18.4.2) Control limits ±25% from the known LCS value
Laboratory Sample Duplicate	One per analytical batch	|ZDup | ≤3. Investigate recurrent results with |ZDup|≥2 (MARLAP 18.4.1) or duplicate error ratio (RER) between the sample and the duplicate is ≤ 1 Relative percent difference (RPD) limit of ≤25%	Check for lab error. Examine the project-specific requirements Contact the client as to additional measures to be taken	Laboratory Manager/Analyst	Precision	RPD limit of ≤25% or RER ≤ 1

B.28.2 SAP Worksheet #28.2: Laboratory Quality Control Samples Table (Gas Flow Proportional Counting Isotopes)

Matrix: Soil						
Beta Emitting Radionuclides						
EPA 905.0/ST-RD-0403						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
Instrument Contamination Check	Daily or when working with long count times, before and after each analytical batch Check after counting high activity samples	Use a statistical test to determine a change in the background count rate value (MARLAP 18.5.6.4; EPA et al., 2004) Or Within ±3σ of mean activity of recent BSCs (minimum of three BSCs)	Check control chart for trend and recount. Recount the background. If still out of control, locate and correct problem. If background activity has changed, re-establish BSC and reanalyze samples If possible, reanalyze or qualify impacted samples since last acceptable instrument contamination check	Laboratory Manager/Analyst	A means of assessing the existence and magnitude of contamination introduced via the analytical process	Statistical test or Within ±3σ of mean activity of recent BSCs (minimum of three BSCs)
Method blank	One per preparation batch (MARLAP 18.4.1)	|ZBlank |≤3 Investigate recurrent results with |ZBlank |≥2 (MARLAP 18.4.1) Or In-house control limits of ± 3σ of mean	Recount the blank to confirm results, unless sample results are > 5 times the blank activity. Inspect the MB control chart for indication of significant bias. If required, re-prepare and reanalyze MB and samples processed with the contaminated blank.	Laboratory Manager/Analyst	Accuracy/Bias/Contamination	|ZBlank |≤3 Investigate recurrent results with |ZBlank |≥2 In-house control limits of ± 3σ of mean Or blank results can not affect project decisions
LCS	One per analytical batch	$\|Z_{LCS}\|$≤3 Investigate recurrent results with $\|Z_{LCS}\|$≥2 (MARLAP 18.4.3) Recovery limits: 75–125%	Recount the LCS to confirm results. Inspect LCS control chart for indication of significant bias If required, re-prep and reanalyze the LCS and associated samples	Laboratory Manager/Analyst	Accuracy	$\|Z_{LCS}\|$≤3. Investigate recurrent results with $\|Z_{LCS}\|$≥2 Recovery limits: 75–125%
Laboratory Sample Duplicate	One per analytical batch per matrix	|ZDup | ≤3 Investigate recurrent results with |ZDup|≥2 (MARLAP 18.4.1) RPD limit of ≤25% or concentrations below the DLC RER ≤ 1	Check for lab error. Examine the project-specific requirements Contact the client as to additional measures to be taken	Laboratory Manager/Analyst	Precision	RPD limit of ≤25% or RER ≤ 1

Matrix: Soil						
Beta Emitting Radionuclides						
EPA 905.0/ST-RD-0403						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
Tracers (if used)	Added to each sample (MS not required when yield tracers are employed)	Recovery (isotopic yield) within 30–110%	Reanalysis of sample, including sample preparation If reanalysis is not possible, qualify data and narrate	Laboratory Manager/Analyst	Accuracy	Recovery (isotopic yield) within 30–110%
Carriers (if used)	Added to each sample as chemical yield monitor	Chemical yield within 30–110%	Reanalysis of sample, including sample preparation If reanalysis is not possible, qualify data and narrate	Laboratory Manager/Analyst	Accuracy	Chemical yield within 30–110%

B.28.3 SAP Worksheet #28.3: Laboratory Quality Control Samples Table (Alpha Spectroscopy)

Matrix: Solid						
Alpha Spectroscopy						
U.S. Department of Energy A-01-R MOD/SOP ST-RD-0210						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
MB	One per preparatory batch (MARLAP 18.4.1; EPA et al., 2004)	|ZBlank |≤ 3. Investigate recurrent results with |ZBlank| ≥ 2 (MARLAP 18.4.1) Or in-house control limits of ± 3σ of the mean	Recount the blank to confirm results. Inspect MB control chart for indication of significant bias If required, re-prep and reanalyze MB and samples processed with the contaminated blank	Laboratory Manager/Analyst	Accuracy	|ZBlank |≤ 3. Investigate recurrent results with |ZBlank| ≥ 2 No analytes detected > target DL
LCS	1 per preparatory batch	$\|Z_{LCS}\|$≤ 3. Investigate recurrent results with $\|Z_{LCS}\|$≥ 2 (MARLAP 18.4.3) Recovery limits: 75–125%	Recount the LCS to confirm results Inspect LCS control chart for indication of significant bias If required, re-prep and reanalyze the LCS and associated samples	Laboratory Manager/Analyst	Accuracy	Recovery limits: 75–125%
Tracers	Added to each sample as isotopic yield monitor (MS not required when yield tracers are employed)	Isotopic yield within 30–110% FWHM < 100 keV and peak energy within ± 40 keV of known peak energy	Reanalysis of sample, including sample preparation If reanalysis is not possible, qualify data and narrate	Laboratory Manager/Analyst	Accuracy	Isotopic yield within 30–110%
Carriers (if used)	Added to each sample as chemical yield monitor	Chemical yield within 30-110%	Reanalysis of sample, including sample preparation If reanalysis is not possible, qualify data and narrate	Laboratory Manager/Analyst	Accuracy	Chemical yield within 30–110%
Laboratory Sample Duplicate	One per analytical batch per matrix	|ZDup | ≤ 3. Investigate recurrent results with |ZDup|≥ 2 (MARLAP 18.4.1) RPD limit of ≤25% or RER ≤ 1	Check for lab error. Examine the project-specific requirements Contact the client as to additional measures to be taken	Laboratory Manager/Analyst	Precision	RPD limit of ≤ 25% or RER ≤1

B.28.4 SAP Worksheet #28.4: Laboratory Quality Control Samples Table—EPA Method 8015

Matrix: Soil						
Total Petroleum Hydrocarbons by Gas Chromatograph						
EPA Method 8015						
QC Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
ISs (optional)	Every sample, spiked sample, standard, and MB	Areas within -50% to +100% of last calibration verification	Identify problem; if not related to matrix interference, then re-extract and reanalyze affected samples	Laboratory Manager/Analyst	Quantitation	Areas within 50% to +100% of last calibration verification
MB	One per analytical batch (TPH as gasoline) and one per preparation batch (TPH as diesel)	No analytes detected >½ LOQ and >1/10 the amount measured in sample or 1/10 the regulatory limit (whichever is greater) Blank result must not otherwise affect sample results	Determine the source of contamination, reanalyze blank, then re-extract and reanalyze MB and samples processed with the contaminated blank	Laboratory Manager/Analyst	Representative-ness	No analytes detected >½ LOQ and >1/10 the amount measured in sample or 1/10 the regulatory limit
LCS or LCS/LCSD	One LCS or LCS/LCSD pair per analytical/preparation batch	Control limits—Attachment B-2	Re-prep and reanalyze the LCS and samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Laboratory Manager/Analyst	Precisions and Accuracy	Control limits—Attachment B-2
MS/MSD for analytes	One MS/MSD pair per preparation batch Batch = 20 samples or less	Control limits—Attachment B-2	Examine the project-specific DQOs. If the MS falls outside of DoD criteria, evaluate matrix effects.	Laboratory Manager/Analyst	Precision and Accuracy	Control limits—Attachment B-2
Surrogate standards	Every sample, spiked sample, standard, and MB	Control limits—Attachment B-2	For QC and field samples, correct problem then re-prep and reanalyze failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary	Laboratory Manager/Analyst	Accuracy	Control limits—Attachment B-2

B.28.5 SAP Worksheet #28.5: Laboratory Quality Control Samples Table—Inductively Coupled Plasma/Mass Spectrometry

Matrix: Solid						
Inductively Coupled Plasma Metals						
EPA Method 6020						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
Calibration blank	Immediately after the ICV and after every CCV	No analytes detected > ½ LOQ < 1/10th the amount measured in sample	Determine source of blank contamination and correct problem Re-prep and reanalyze calibration blank Samples following the last acceptable calibration blank must be reanalyzed	Laboratory Manager/Analyst	Representative-ness	No target analytes ≥½ LOQ
MB	One per digestion batch	No analytes detected > ½ LOQ < 1/10th the amount measured in sample	Determine source of blank contamination If required, re-prep and reanalyze MB and samples processed with the contaminated blank	Laboratory Manager/Analyst	Representative-ness	No target analytes ≥½ LOQ
Interference check solution (ICS)	After ICAL and prior to sample analysis	ICS-A—Absolute value of concentration for non-spiked analytes < ½ LOQ (unless they are a verified trace impurity from one of the spiked analytes) ICS-AB: Within ±20% of true value	Terminate analysis, perform maintenance to correct the problem reanalyze ICS and affected samples	Laboratory Manager/Analyst	Accuracy	Within ±20% of expected value
LCS or LCS/LCD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCD pair per each preparation batch	Control limits—Attachment B-2	Determine source of LCS failure and correct problem, then re-prep and reanalyze the LCS and samples in the associated preparatory batch if enough sample material is available	Laboratory Manager/Analyst	Precision and Accuracy	Control limits—Attachment B-2
MS/MSD for analytes	One MS/MSD pair per preparation batch	Control limits—Attachment B-2	Examine the project-specific DQOs If the MS falls outside of DoD criteria, evaluate matrix effects Perform post-digestion spike	Laboratory Manager/Analyst	Precision and Accuracy	Control limits—Attachment B-2
Post-Digestion Spike	Perform if MS/MSD fails One per preparation batch (using the same sample as MS/MSD)	Control Limits—Recovery 80–120%	Narrate the results	Laboratory Manager/Analyst	Precision and Accuracy	Control Limits—80–120%

Matrix: Solid						
Inductively Coupled Plasma Metals						
EPA Method 6020						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
Dilution test	One per preparatory batch If MS/MSD fails Only applicable for samples with concentrations >50 × LOQ (prior to dilution)	Five-fold dilution must agree within ±10% of the original measurement	Evaluate for matrix interference Use along with MS/MSD and post-digestion spike data to confirm matrix effects	Laboratory Manager/Analyst	Accuracy	10% Difference

B.28.6 SAP Worksheet #28.6: Laboratory Quality Control Samples Table—EPA Method 8270

Matrix: Soil						
Semivolatile Organic Compounds and Polycyclic Aromatic Hydrocarbons						
EPA Method 8270/8270-SIM						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
Surrogate standards	Every sample, spiked sample, standard, and MB	Control limits—Attachment B-2	For QC and field samples, correct problem then re-prep and reanalyze failed samples for failed surrogates in the associated preparatory batch, if enough sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary	Laboratory Manager/Analyst	Accuracy	Control limits—Attachment B-2
MB	One per analytical batch	No analytes detected >½ LOQ and >1/10 the amount measured in sample or 1/10 the regulatory limit	Correct problem; If required, re-prep and reanalyze MB and samples processed with the contaminated blank	Laboratory Manager/Analyst	Representative-ness	No analytes detected >½ LOQ and >1/10 the amount measured in sample or 1/10 the regulatory limit
MS/MSD	One MS/MSD per analytical/preparation batch	Control limits—Attachment B-2	Identify problem; if not related to matrix interference, re-extract and reanalyze MS/MSD and associated batch samples	Laboratory Manager/Analyst	Precision and Accuracy	Control limits—Attachment B-2
LCS or LCS/LCSD	One per preparatory batch	Control limits—Attachment B-2	Determine the source of the problem and correct, then re-prep and reanalyze the LCS and samples in the associated preparatory batch for failed LCS analytes, if enough sample material is available	Laboratory Manager/Analyst	Precision and Accuracy	Control limits—Attachment B-2

B.28.7 SAP Worksheet #28.7: Laboratory Quality Control Samples Table—EPA Methods 8081/8082

Matrix: Soil						
Organochlorine Pesticides and Polychlorinated Biphenyls						
EPA Methods 8081/8082						
QC Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
MB	One per preparation batch	No analytes detected >½ LOQ and >1/10 the amount measured in sample or 1/10 the regulatory limit	Determine the source of blank contamination and correct problem If required, re-prep and reanalyze MB and samples processed with the contaminated blank	Laboratory Manager/Analyst	Representative-ness	No analytes detected >½ LOQ and >1/10 the amount measured in sample or 1/10 the regulatory limit
MS/MSD for analytes	One MS/MSD pair per analytical/preparation batch	Control limits—Attachment B-2	Examine the project-specific DQOs Contact the client as to additional measures to be taken	Laboratory Manager/Analyst	Precisions and Accuracy	Control limits—Attachment B-2
LCS or LCS/LCSD Containing Analytes Reported	One LCS or LCS/LCSD pair per analytical/preparation batch	Control limits—Attachment B-2	Determine the source of the problem and correct, then re-prep and reanalyze the LCS and samples in the associated preparatory batch for failed analytes, if sufficient sample material is available	Laboratory Manager/Analyst	Precisions and Accuracy	Control limits—Attachment B-2
Surrogate Standards	Every sample, spiked sample, standard, and MB	Control limits—Attachment B-2	Determine the source of problem, if related to matrix narrate or re-prep and reanalyze samples for failed surrogates in the associated preparatory batch, if enough sample material is available If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary	Laboratory Manager/Analyst	Accuracy	Control limits—Attachment B-2
Confirmation of positive results (second column or second detector)	Positive results must be confirmed	Calibration and QC criteria same as for initial or primary column analysis If results between primary and second column RPD ≤40% (report result from primary column)	If results between primary and second column RPD > 40% review the chromatogram, evaluate possible matrix interference on either column, and if no interference, narrate and report the lesser value with a qualifier	Laboratory Manager/Analyst	Accuracy	Analyte concentration % difference between columns ≤40%

B.28.8 SAP Worksheet #28.8: Laboratory Quality Control Samples Table—Mercury

Matrix: Soil						
Mercury						
EPA Method 7471						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence	No analytes detected >LOD	Determine source of blank contamination and correct problem Re-prep and reanalyze calibration blank Samples following the last acceptable calibration blank must be reanalyzed	Laboratory Manager/Analyst	Representative-ness	No target analytes ≥LOD
MB	One per digestion batch	No analytes detected >½ LOQ and >1/10 the amount measured in sample or 1/10 the regulatory limit	Determine source of blank contamination and correct problem If required, re-prep and reanalyze MB and samples processed with the contaminated blank	Laboratory Manager/Analyst	Representative-ness	No analytes detected >½ LOQ and >1/10 the amount measured in sample or 1/10 the regulatory limit
LCS or LCS/LCSD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCSD pair per each preparation batch	% Recovery 80–124% RPD≤20%	Determine the source of the problem and correct, then re-prep and reanalyze the LCS and samples in the associated preparatory batch for failed analytes	Laboratory Manager/Analyst	Precision/Accuracy	% Recovery 80%-124% RPD≤20%
MS/MSD for analytes	One per preparatory batch per matrix	% Recovery 80–124% RPD≤20%	Determine the source of problem, if related to matrix, narrate Or re-prep and reanalyze samples for failed MS/MSD in the associated preparatory batch	Laboratory Manager/Analyst	Precision/Accuracy	% Recovery 80%-124% RPD≤20%
Dilution test	One per preparatory batch	Five-fold dilution must agree within ±10% of the original measurement.	Evaluate for matrix interference Perform post-digestion spike	Laboratory Manager/Analyst	Accuracy	10% Difference, only applicable with sample Concentrations >50 × LOQ

B.28.9 SAP Worksheet #28.9: Laboratory Quality Control Samples Table—EPA Method 8260

Matrix: Soil						
Volatile Organic Compounds						
EPA Method 8260						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
MB	One per analytical batch	No target analytes ≥½ LOQ For common laboratory contaminants, no analytes detected >LOQ	Determine the source of contamination and correct the problem. If required, re-prep and reanalyze MB and samples processed with the contaminated blank	Laboratory Manager/Analyst	Representative-ness, bias contamination	No target analytes ≥½ LOQ. For common laboratory contaminants, no analytes detected >LOQ
MS/MSD	One MS/MSD per analytical/preparation batch	Control limits—Attachment B-2	Determine if MS/MSD failure due to matrix interference Examine the project-specific DQOs; Contact the client as to additional measures to be taken	Laboratory Manager/Analyst	Precision/Accuracy	Control limits—Attachment B-2
LCS or LCS/LCD	One per preparatory batch	Control limits—Attachment B-2	Determine the source of LCS failure, correct the problem, then re-prep and reanalyze the LCS and samples in the associated preparatory batch for failed analytes, if enough sample material is available	Laboratory Manager/Analyst	Precision/Accuracy	Control limits—Attachment B-2
Surrogate standards	Every sample, spiked sample, standard, and MB	Control limits—Attachment B-2	For QC and field samples, correct problem then re-prep and reanalyze failed samples for failed surrogates in the associated preparatory batch, if enough sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary	Laboratory Manager/Analyst	Accuracy	Control limits—Attachment B-2

B.28.10 SAP Worksheet #28.10: Laboratory Quality Control Samples Table—Asbestos

Matrix: Soil						
Asbestos						
SOP/Asbestos—California Air Resources Board 435 (EM-AS-S-1265)						
QC Check	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicator**	**Measurement Performance Criteria**
Blank	One MB daily	Result <Reporting Limit	Narrate/recount/reanalyze batch	Laboratory Manager/Analyst	Bias—contamination	Result <RL
Sample Duplicate	Asbestos—1 per 50 samples	RPD <50%	Recount batch	Laboratory Manager/Analyst	Precision	RPD <50%
Confirmation—asbestos	10 percent of the analyzed confirmation of the quantitation result by a second analyst	Confirmation of initial results	Recount/reanalyze batch	Laboratory Manager/Analyst	Accuracy/precision	Confirmation of initial results

B.29 SAP Worksheet #29: Project Documents and Records Table

Document	Where Maintained
Final work plan and SAP	APTIM project file (APTIM project storage) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Field notes/logbook	APTIM project file (APTIM Concord, California office)
COC Forms	APTIM project file (APTIM Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Laboratory raw data package	APTIM project file (APTIM Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Corrective action forms/reports	APTIM project file (APTIM Concord, California office) and laboratory
Laboratory equipment calibration logs	APTIM project file (APTIM Concord, California office) and laboratory
Sample preparation logs	APTIM project file (APTIM Concord, California office) and laboratory
Run logs	APTIM project file (APTIM Concord, California office) and laboratory
Data validation reports and validated data	APTIM project file (APTIM Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites If required, validated electronic data will be loaded into Naval Installation Restoration Information Solution, the Navy's centralized database

Notes:
Active project files will be maintained by the PM until project completion. Following project completion, hardcopy files will be stored for minimum of 10 years.
Documents submitted to the NAVFAC SW Environmental Restoration Program Record File are located at:

Commanding Officer
Naval Facilities Engineering Systems Command Southwest
1220 Pacific Highway (Naval Base San Diego Bldg. 3519)
San Diego, CA 92132

Following response complete at the facility, hardcopy deliverables will be archived by the Navy at a Federal Records Center (http://www.archives.gov/frc/locations.html) where they are maintained for 50 years.

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B.30 SAP Worksheet #30: Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical Method	Data Package Turnaround Time	Laboratory/Organization[1] (Name, Address, Contact, and Telephone No.)	Backup Laboratory (Name, Address, Contact, and Telephone No.)
Soil	All	Radiological samples shown in Worksheet #18	All	28–35 calendar days	Eurofins Test America St. Louis and Denver Laboratory Contact: Rhonda Ridenhower 13715 Rider Trail North Earth City, Missouri 63045 314.298.8566	None
Water	All	Radiological samples shown in Worksheet #18	All	28–35 calendar days	Eurofins Test America St. Louis and Denver Laboratory Contact: Rhonda Ridenhower 13715 Rider Trail North Earth City, Missouri 63045 314.298.8566	None

Notes:
[1] Analytical laboratories performing analyses will be State of California and DoD Environmental Laboratory Accreditation Program-accredited laboratories. Certifications provided in Attachment B-2

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B.31 SAP Worksheet #31: Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Laboratory Technical Systems Audit	If deemed necessary prior to start of sampling activities	External	APTIM	APTIM Project or Program Chemist	Laboratory QA Officer	Laboratory QA Officer	Laboratory QA Officer and APTIM Project Chemist
Initial Inspection/Preparatory Meeting	Prior to the start of sampling activities	Internal	APTIM	APTIM Project or Program Chemist	Project Chemist or Sample Technician	Project Chemist or Sample Technician	Program Chemist or QC Manager
Field audits	As needed as the project progresses	Internal	APTIM and/or Navy QA Officer	APTIM Project or Program Chemist	Project Chemist or Program Chemist	Project Chemist or Program Chemist	Project Chemist or Program Chemist

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Field documentation review	At least once at the beginning of sampling activities and then as needed as the project progresses	Internal	APTIM	APTIM Program Chemist or Field QA Manager	APTIM PM; Field Sampling Technician or Project Chemist	APTIM PM; Field Sampling Technician or Project Chemist	APTIM Program Chemist or Field QA Manager

B.32 SAP Worksheet #32: Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Technical Systems Audit	Written Audit Report	Project PM	48 hours after audit	Email or letter	Field Technician, APTIM Project Chemist, APTIM Program Chemist	24 hours after notification
Off-Site Laboratory Audit (if performed for project)	Written Audit Report	Laboratory QA Manager, Laboratory PM (TestAmerica St. Louis)	5 days after audit	Corrective Action Plan	Field Technician, APTIM Project Chemist, APTIM Program Chemist	10 business days after receiving report
Laboratory Data Review Findings	Memorandum	Laboratory QA Manager, Laboratory PM (TestAmerica St. Louis)	48 hours after audit	Email or letter	Field Technician, APTIM Project Chemist, APTIM Program Chemist	3 days after notification

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B.33 SAP Worksheet #33: QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Sampling Technical System Audit Report	At least once at the beginning of sampling activities and then as needed as the project progresses	Within 24 hours of field sampling audit	APTIM QA Manager or APTIM Project Chemist	APTIM PM
Off-Site Laboratory Technical System Audit Report (if performed)	Prior to sample receipt at laboratory	Within 48 hours of on-site audit	APTIM Project Chemist or APTIM Program Chemist	Laboratory QA Manager, Laboratory PM
Data Review Report	After waste sample data reviewed by Project Chemist	As received from laboratory	APTIM Project Chemist or APTIM Program Chemist	APTIM PM
Final Project Report (if needed)	After completion of fieldwork	Project document delivery schedule is provided in the work plan	APTIM PM	Navy RPM and regulatory agencies (see distribution list)

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B.34 SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table

Data Review Input	Description	Responsible for Verification	Step I/IIa/IIb[1]	Internal/External
COCs	COCs will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC should be initialed by the reviewer, a copy of the COC retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	Field sampling team leader (APTIM) or Project Chemist	Step I	Internal
Sample receipt	The sample cooler will be checked for compliance with preservative, temperature and packaging requirements. Sample containers will be reviewed against the COC for agreement. Sample receipt will be documented by the laboratory on a login sheet and sample information will be entered into the Laboratory Information Management System.	Laboratory sample receiving and PM	Step I	External
Field notes/logbook	Field notes will be reviewed internally and placed in the project file upon project completion.	APTIM Project Chemist and Field QC Manager	Step I	Internal
Audit reports	Upon report completion, a copy of audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that appropriate	APTIM PM	Step I	Internal

Data Review Input	Description	Responsible for Verification	Step I/IIa/IIb[1]	Internal/External
	corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the PM will be notified to ensure action is taken.			
Laboratory data packages	Laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. Received data packages will be verified by the APTIM Chemist and a third-party reviewer according to the data validation procedures specified in this SAP.	Laboratory PM and APTIM Project Chemist	Step I	Internal/External
EDD	EDDs will be verified internally by the subcontract laboratory for completeness and technical accuracy prior to submittal to APTIM. Received EDDs will be verified APTIM and/or the validation company against the hardcopy laboratory reports.	Laboratory, APTIM Chemist and a third-party data validation company	Step I	Internal/External
Sampling methods and procedures	Ensure that the required sampling methods were used to collect project samples, field changes or deviations are noted in the field logbook. Review field sample collection logbooks for compliance with the approved SAP.	APTIM Project Chemist and Field QC Manager	Step IIa	Internal
Holding times	Ensure the samples were analyzed within the EPA holding times. If holding times were not met, verify that deviations were documented and proper notifications were made.	Laboratory PM	Step IIa	External
Analytes and project DLCs met	Ensure that the required list of analytes and that project-specific DLCs specified in this SAP are met and reported per project requirements.	Laboratory PM and Project Chemist	Step IIa	Internal/External

Data Review Input	Description	Responsible for Verification	Step I/IIa/IIb[1]	Internal/External
Hard copy data packages	Review data package for completeness	Third-party validation company	Step IIb	External
Documentation of SAP QC sample results	Determine if SAP required QC samples were collected and met required control limits per SAP and DoD QSM (2019a) requirements when applicable.	Third-party validation company	Step IIb	External
Sampling Plan	Determine whether the SAP was executed as specified (number, location, type of field samples collected).	APTIM Project QC Manager or Project Chemist	Step IIb	Internal
Characterization Radiological Analyses	Review/validate laboratory data package for compliance with EPA Method requirements (1996, 2008), DoD QSM (2019a) and requirements in this approved SAP.	Third-party validation company	Step IIb	External

Notes:
[1] IIa = compliance with methods, procedures, and contracts (see Table 10, page 117, *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs* [EPA, 2005]).
IIb = comparison with measurement performance criteria in the SAP (see Table 11, page 118, *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs* [EPA, 2005]).

B.34.1 Validation of Laboratory Data

Data validation is a systematic, independent process of reviewing a body of data to determine the analytical limitations of that data based on specific QC criteria. A third-party data validation company will validate definitive-level project laboratory data for radiological characterization samples if collected at 90 percent Stage 2B and 10 percent Stage 4.

Wastewater and waste soil sample data will not be validated by a third-party validation company but will be reviewed by the APTIM Project Chemist.

Data review and validation will be in accordance with the QA requirements and control limits specified in this project-specific QA project plan and the following guidance, as appropriate to the analytical methods used:

- DoD QSM (2019a)
- *National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2017)

The Chemist or reviewer's professional judgment will be used to evaluate data quality when called for in the National Functional Guidelines. Professional judgment will also be used where no clear policy exists, or when there is conflicting guidance on how data should be qualified.

B.34.2 Stage 2B and Stage 3 Data Validation Criteria and Checklist

For a Stage 2B data validation effort data quality is assessed by comparing the parameters listed below to the appropriate criteria (or limits) as specified in the project SAP, DoD QSM (2019a), or by EPA Method-specific requirements. If calculations for quantitation are verified, it is done on a limited basis requires raw data (Stage 3) in addition to the standard data forms normally present in a data package.

Quality Control Check	Evaluation	Data Qualification	Samples Affected
Holding Time	Holding time exceeded for extraction, digestion, or analysis	J = positive results; Nondetects = use professional judgment UJ or R	Analytes in sample
Sample Preservation	Chemical analysis only	use professional judgment	
Temperature	Chemical analysis only	use professional judgment	
ICAL (See Worksheet #24 for criteria)			

Quality Control Check	Evaluation	Data Qualification	Samples Affected
Energy	Energy difference outside criteria	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	Associated analytes in samples in analytical batch
Efficiency	Efficiency difference outside criteria	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	
FWHM peak resolution	FWHM peak resolution outside criteria	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	
ICV	Observed peaks in ICV greater than 10% of ICAL value	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	Associated analytes in samples in analytical batch
CCV (Daily Check)	Energy, efficiency, or FWHM outside criteria	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	Associated analytes in samples in analytical batch
BSC	Background count rate of entire spectrum > 3σ of the average	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	Associated samples in analytical batch

Quality Control Check	Evaluation	Data Qualification	Samples Affected
LCS	%R >UCL	Sample > DLC; qualify as estimated (J) Sample < DLC; None required	Associated analytes in samples in preparation batch or analytical batch
	%R < Lower Control Limit but ≥ 30%	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	
	%R <30%	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as unusable (R)	
Method Blank	Blank < DLC	None required	Associated analytes in samples in preparation batch or analytical batch
	Blank > DLC	Sample < DLC; None required Sample > DLC by < 10x blank; qualify as estimated (J) Sample > 10x blank; None required	

Quality Control Check	Evaluation	Data Qualification	Samples Affected
Tracer Recovery (alpha spectroscopy only) Carrier Recovery (GFPC ony)	%R >UCL	Sample > DLC; qualify as estimated (J) Sample < DLC; None required	Associated analytes in affected samples
	%R < Lower Control Limit but ≥ 10%	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	
	%R <10%	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as unusable (R)	
LCS Duplicates	Concentration of reported analytes are > 5x the DLC in either sample and RPD ≥ 25% and/or RER ≥ 1	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	Analytes in parent sample
	Concentration of reported analytes are < 5x the DLC in either sample and absolute difference > 3x DLC	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	

Quality Control Check	Evaluation	Data Qualification	Samples Affected
MS	%R >UCL	Sample > DLC; qualify as estimated (J) Sample < DLC; None required	Associated analytes in samples in preparation batch or analytical batch
	%R < Lower Control Limit but ≥ 30%	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	
	%R <30%	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as unusable (R)	
Field Duplicates	Concentration of reported analytes are > 5x the DLC in either sample and RPD ≥ 25% and/or RER ≥ 1	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	Analytes in parent sample and field duplicate
	Concentration of reported analytes are < 5x the DLC in either sample and absolute difference > 3x DLC	Sample > DLC; qualify as estimated (J) Sample < DLC; qualify as estimated (UJ)	

B.35 SAP Worksheet #37: Usability Assessment

B.35.1 Data Quality Assessment Report

Based on data validation/review, the Project Chemist or Project RSO will determine if the project DQOs have been met and will determine data usability. To reconcile the collected data with project DQOs and to establish and document data usability, the data will be reviewed against data quality indicators (Section B.35.2).

If necessary, the Project Chemist will prepare a data quality assessment (DQA) report. The DQA report will cover the following topics:

- Implementation of sampling design and analysis according to the approved SAP (or sample completeness and representativeness)
- Proper frequency of field QC samples and the adequacy of field decontamination procedures
- Accuracy and precision of the data collected
- Data comparability, if appropriate
- Data usability for project decisions

The DQA report will be included in the final project report.

B.35.2 Data Quality Indicators

This section defines the data quality indicators and their use for assessment of data quality.

B.35.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. The following equation illustrates the method for calculating the RPD to assess a method's precision:

$$\text{Precision as RPD} = \frac{2 \times |\text{Result-Duplicate Result}| \times 100\%}{\text{Result + Duplicate Result}}$$

The laboratory uses MS/MSD pairs to assess the precision of analytical procedures, with one MS/MSD pair analyzed for every batch of up to 20 samples. According to the

Navy requirements, analytical laboratories perform MS/MSD on the Navy project samples. This allows determining whether matrix interferences may be present.

The laboratory uses LCS/duplicate pairs when MS are not practical due to the nature of sample or analytical method used, and they are prepared and analyzed with each batch of samples instead of MS/MSD. The LCS/duplicate may also be prepared in place of MS/MSD in the case that a sufficient sample volume was not obtained in the field to perform the MS/MSD analysis. For inorganic analyses, analytical precision is usually calculated based on the sample and sample duplicate results.

Analytical laboratory will use DoD QSM (2019a) acceptability limits for RPDs if available. If DoD limits are not available, then the laboratory will establish statistically based acceptability limits for RPDs for each method of analysis and sample matrix. The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. Suspect trends will be investigated and corrective actions taken.

The analytical laboratory will use DoD QSM (2019a) control limits if available; otherwise, the laboratory will have statistically based acceptability limits for RPDs established for each method of analysis and sample matrix. The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. Suspect trends will be investigated and corrective actions taken.

Due to the heterogeneous nature of site soil, field duplicates cannot be used to assess sampling precision; therefore, soil field duplicates will not be collected for this project.

B.35.2.2 Accuracy

Accuracy measures the bias of an analytical system by comparing the difference of a measurement with a reference value. The percent recovery of an analyte, which has been added to the environmental samples at a known concentration before extraction and analysis, provides a quantitation tool for analytical accuracy. The spiking solutions used for accuracy determinations are not used for instrument calibrations. The following equation illustrates how accuracy is evaluated:

$$\text{Accuracy as percent recovery} = \frac{\text{Spiked Sample Result-Sample Result x 100\%}}{\text{Spiked Sample True Value}}$$

Percent recoveries for MS, MSD, and LCS that are analyzed for every batch of up to 20 samples serve as a measure of analytical accuracy. Surrogate standards are added to

samples, blanks, MSs, MSDs, and LCSs analyzed for organic contaminants to evaluate the method's accuracy and to help determine matrix interferences.

The laboratory will use DoD QSM (2019a) control limits for accuracy if available. For analytes not specified in the QSM, the laboratory may use statistically based control limits are developed for each method of organic analysis and sample matrix.

Control limits are defined as the mean recovery, plus or minus three standard deviations, of the 20 data points, with the warning limits set as the mean plus or minus two standard deviations. The laboratory will review the QC samples and surrogate standard recoveries for each analysis to ensure that internal QC data lie within the limits of acceptability. The laboratory will investigate suspect trends and take appropriate corrective actions.

B.35.2.3 Representativeness

Unlike precision and accuracy, which can be expressed in quantitative terms, representativeness is a qualitative parameter. Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on proper design of the sampling program.

Field personnel will be responsible for ensuring that samples are representative of field conditions by collecting and handling samples according to the approved site-specific SAP. Errors in sample collection, packaging, preservation, or COC procedures may result in samples being judged nonrepresentative and may form a basis for rejecting the data.

Data generated by the laboratory must be representative of the laboratory database of accuracy and precision measurements for analytes in different matrices. Laboratory procedures for sample preparation will ensure that aliquots used for analysis are representative of the whole sample. Aliquots to be analyzed for volatile parameters will be removed before the laboratory composites/homogenizes the samples, to avoid losing volatile compounds during mixing.

B.35.2.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another, whether it was generated by a single laboratory or

during inter-laboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data.

Sample collection and handling procedures will adhere to EPA-approved protocols. Laboratory procedures will follow standard analytical protocols; use standard units and standardized report formats; follow the calculations as referenced in the approved analytical methods; and use a standard statistical approach for QC measurements.

B.35.2.5 Completeness

Completeness is a measure of whether the data necessary to meet the project have been collected. For the data to be considered complete, they must meet acceptance criteria including accuracy and precision and other criteria specified for an analytical method. The data will be reviewed and/or validated to keep invalid data from being processed through data collection. Completeness is evaluated using the following equation:

$$\text{Completeness} = \frac{\text{Acceptable Results x 100\%}}{\text{Total Results}}$$

The goal for completeness for QC parameters, except holding times, will be 90 percent. The goal for holding times will be 100 percent. If these goals are not achieved, the sources of nonconformances will be evaluated to determine whether resampling and reanalysis is necessary.

B.35.3 Sensitivity

Sensitivity is the capability of a method or instrument to measure target analyte responses. Sensitivity determines the minimum concentration or attribute that can be measured by a method (method DL), by an instrument (instrument DL), or by a laboratory (LOD). The laboratory DLC, LOD, or DL will be sensitive enough to meet the project decision limits. Sensitivity may be affected by sample matrix factors such as interference of non-target analytes, sample materials, or sample dilution.

The DLC will be evaluated by the project team prior to sample analysis to determine if the laboratory is able to attain the required sensitivity for the project. The DLC be evaluated after sample analysis to determine if there were matrix effects, operator errors, or analytical process errors that interfered with the ability to compare the results to the project decision limits. The DLC will be used to determine if no detectable

amounts of contaminants of concern are present. If no detectable amounts are reported and data are acceptable from the verification and validation, then the data is usable. If detectable amounts are reported and the verification and validation are acceptable, then the data is usable. If anomalies in sensitivity are present, the rationale for use or non-use of the affected samples will be discussed in the DQA report.

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FIGURE

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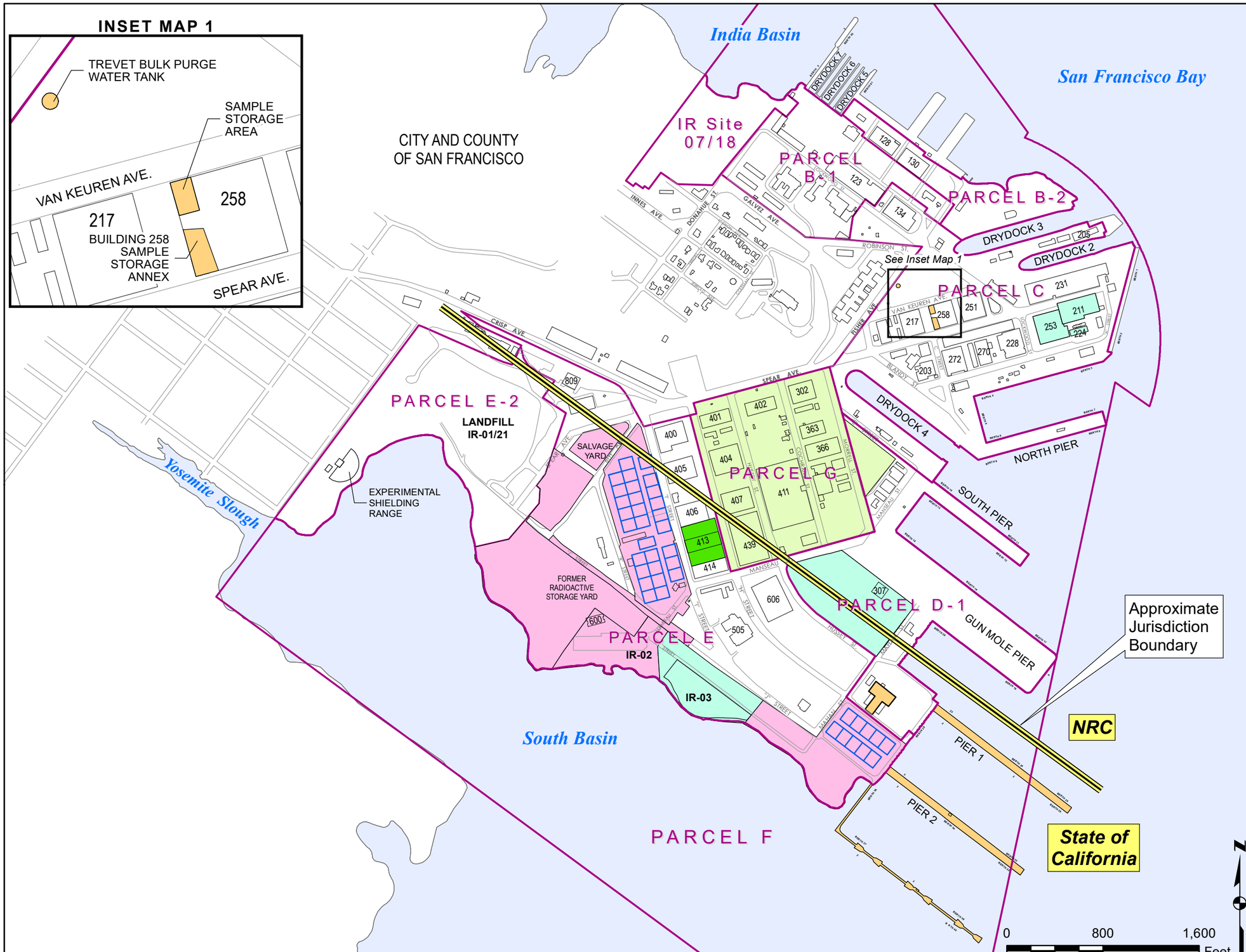

U.S. Department of the Navy
BRAC PMO West
San Diego, California

FIGURE B-1
RADIOLOGICAL AREAS UNDER CONTRACT
(FEBRUARY 12, 2021)

BASEWIDE RADIOLOGICAL SUPPORT
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

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ATTACHMENT B-1
FIELD FORMS

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Appendix B

APTIM

CHAIN OF CUSTODY

Ref. Document # 501730-001

Page 1 of 1

APTIM Federal Services, LLC
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 501730
Project Name: Hunters Point Naval Shipyard: Basewide Rad Support
Project Location: San Francisco, CA
Purchase Order #: 204589
Shipment/Pickup Date:
Waybill Number:
Lab Destination: TestAmerica (St. Louis Lab) 13715 Rider Trail North Earth City, MO 63045
Lab Contact Name / ph. #: Rhonda Ridenhower (314) 298-8566

Project Manager: *Lisa Bercik*
(Name & phone #)

Send Report To: *Audrey Engel*
Phone/Fax Number: *916-317-5546*
Address: *4005 Port Chicago Hwy*
City: *Concord, CA, 94520*

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Gamma Spec (EPA 901.1 M) (full 21 day in growth gamma results)	Total Strontium (EPA 905 MOD)		Strontium 90 (EPA 905 MOD)			Dose Rate µR/Hr	
							Preservative (water)								
							Preservative (soil)	N/A	N/A						

Analyses Requested

Special Instructions: 21 day ingrowth results only.

☐ 24-hr
Standard TAT -10-day ☐ 3-day ☐ 10-day

Level Of QC Required: I II **III** Project Specific:

Relinquished By:	Date: / Time:	Received By:	Date: / Time:
Relinquished By:	Date: / Time:	Received By:	Date: / Time:
Relinquished By:	Date: / Time:	Received By:	Date: / Time:
Relinquished By:	Date: / Time:	Received By:	Date: / Time:

Method Codes C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO =Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples
A = Air ABS=Asbestos, PO=Pipe Openning

see next page

CHAIN OF CUSTODY CONTINUATION

Ref. Document # 501008-019

Page 2 of 4

Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:
Relinquished By:	Date: Time:	Received By:	Date: Time:

Aptim Federal Services LLC

DATE			
TIME			
PAGE	1	OF	1
PROJECT NO.	**501730**		

SAMPLE COLLECTION LOG

PROJECT NAME **HPNS Basewide Rad Support**

SAMPLE LOCATION

SAMPLE TYPE ☐ Soil ☐ Water ☐ Air ☐ Other (give description)

COMPOSITE ☐ YES ☐ NO

COMPOSITE TYPE

DEPTH OF SAMPLE

WEATHER

MAP Below ☐

ANALYSES		CONTAINER AND AMOUNT COLLECTED
☐ PCBs	☐ PAHs	☐ 8 - OZ JARS
☐ Metals	☐ OCP	☐ 4 - OZ JARS
☐ TPH	☐ SVOC	☐ TerraCore
☐ Gamma Spec		☐ 24 - OZ JARS

Sample ID	Location	Depth (ft)	Analysis	Notes

Collected By: _____ Date: _____ Time: _____

Relinquished to: _____ Date: _____ Time: _____

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ATTACHMENT B-2
CONTROL LIMITS, CERTIFICATIONS, AND ANALYTICAL STANDARD OPERATING PROCEDURES

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Letter to authorize government agencies to post or publish TestAmerica SOPs.

Diane Silva, NARA Certified Command Records Manager
NAVFAC Southwest
1220 Pacific Highway, Code EV33
NBSD Bldg. 3519
San Diego, CA 92132

To whom it may concern:

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Sincerely,

Jodie Carnes
Laboratory Director

Appendix C: Laboratory Control Sample (LCS) Control Limits and Requirements

1.0 INTRODUCTION

The DoD Environmental Data Quality Workgroup (EDQW) determined that both DoD and DOE would benefit from updating the existing Laboratory Control Sample (LCS) control limits that were established as a result of a study conducted in 1999 and reported in the 2004 LCS study. The initial study in 2004 was based on a limited data set and did not include all the laboratories and methods that are now a part of DoD ELAP and DOECAP-AP. The objective of the new study was to develop updated LCS limits and provide values for an expanded scope of methods.

The new LCS study, conducted in the summer of 2012, incorporated the contributions from approximately 50 DoD ELAP and DOECAP-AP accredited/approved laboratories. In all, 6.5 million records were analyzed, and LCS limits were set for 23 methods and approximately 1,280 matrix-method-analyte combinations. Based on the laboratory LCS sample data, control limits were calculated for all matrix-method-analyte combinations that met the criteria (a minimum of 100 records) for having sufficient data. Control limits were calculated as the sample mean (percent recovery) $\pm$ 3 sample standard deviations.

An addendum to the 2012 study was conducted in the fall of 2018 to establish control limits for PFAS compounds for analysis by LCMSMS Compliant with DoD/DOE QSM 5.1 Table B-15. This LCS study incorporated the contributions from 11 DoD ELAP and DOECAP-AP accredited/approved laboratories. In all, over 49 thousand records were analyzed, and LCS limits were set for approximately 49 matrix-method-analyte combinations. Based on the laboratory LCS sample data, control limits were calculated for all matrix-method-analyte combinations that met the criteria (a minimum of 100 records across at least 4 laboratories) for having sufficient data. Control limits were calculated as the sample mean (percent recovery) ± 3 sample standard deviations.

2.0 LCS LIMIT TABLES

Table C-1. Method 1668 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
2051-60-7	PCB 1	148	91.7	14.6	48	136
56558-16-8	PCB 104	152	99.4	6.2	81	118

Table C-1. Method 1668 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
32598-14-4	PCB 105	179	105.6	7.2	84	127
74472-37-0	PCB 114	177	105.4	6.2	87	124
31508-00-6	PCB 118	180	107.7	9.6	79	137
65510-44-3	PCB 123	188	107.2	8.8	81	134
57465-28-8	PCB 126	181	100.8	7.3	79	123
2050-68-2	PCB 15	151	106	13.9	64	148
33979-03-2	PCB 155	153	98.7	7.5	76	121
38380-08-4	PCB 156	176	104.5	6.9	84	125
52663-72-6	PCB 167	181	106.8	8.3	82	132
32774-16-6	PCB 169	181	98.8	7.3	77	121
74487-85-7	PCB 188	150	97.5	6.4	78	117
39635-31-9	PCB 189	176	102.2	5.7	85	119
38444-73-4	PCB 19	151	99.5	8.6	74	125
2136-99-4	PCB 202	150	97.1	7.1	76	118
74472-53-0	PCB 205	150	100	9.4	72	128
40186-72-9	PCB 206	183	97.5	7.8	74	121
52663-77-1	PCB 208	150	100.2	6.6	80	120
2051-24-3	PCB 209	181	107.6	8.4	83	133
2051-62-9	PCB 3	126	97.4	13.2	58	137
38444-90-5	PCB 37	152	104.3	14.4	61	148
13029-08-8	PCB 4	144	98	13.8	57	140
15968-05-5	PCB 54	150	95.9	9.5	67	124
32598-13-3	PCB 77	152	96.5	7	75	118
70362-50-4	PCB 81	150	100.6	7.7	78	124

Table C-2. Method 1668 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
2051-60-7	PCB 1	206	86.7	9.4	58	115
37680-73-2	PCB 101	107	103.8	9.5	75	132

Table C-2. Method 1668 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
56558-16-8	PCB 104	206	99.4	6.9	79	120
32598-14-4	PCB 105	258	104.7	9.3	77	133
74472-37-0	PCB 114	246	106.5	8.7	81	133
31508-00-6	PCB 118	212	104.9	7.7	82	128
65510-44-3	PCB 123	252	106.8	10.2	76	138
57465-28-8	PCB 126	242	98.4	6.8	78	119
38380-07-3	PCB 128	103	102.3	7.8	79	126
2050-68-2	PCB 15	211	103.5	9.8	74	133
33979-03-2	PCB 155	208	97.4	9.5	69	126
38380-08-4	PCB 156	248	107.6	9.9	78	137
52663-72-6	PCB 167	249	110.4	11	78	143
32774-16-6	PCB 169	247	96.9	8.7	71	123
35065-30-6	PCB 170	108	108	10	78	138
74487-85-7	PCB 188	207	95.7	6.5	76	115
39635-31-9	PCB 189	248	102.4	7.2	81	124
38444-73-4	PCB 19	196	98.7	6.5	79	118
2136-99-4	PCB 202	205	95.5	6.2	77	114
74472-53-0	PCB 205	208	95.5	8.8	69	122
40186-72-9	PCB 206	210	93.6	6.6	74	113
52663-77-1	PCB 208	210	98.6	6.4	79	118
2051-24-3	PCB 209	212	103.7	8	80	128
2051-62-9	PCB 3	208	93.6	9.8	64	123
38444-90-5	PCB 37	206	97	12.3	60	134
13029-08-8	PCB 4	207	95	10.9	62	128
15968-05-5	PCB 54	204	95	9.4	67	123
32598-13-3	PCB 77	208	94.1	6.2	75	113
70362-50-4	PCB 81	208	100.6	8	77	125

Table C-3. Method 6010 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7429-90-5	Aluminum	6258	96.7	7.5	74	119
7440-36-0	Antimony	5997	96.4	5.7	79	114
7440-38-2	Arsenic	9530	96.2	4.9	82	111
7440-39-3	Barium	9236	98.3	5	83	113
7440-41-7	Beryllium	6799	97.8	5.1	83	113
7440-42-8	Boron	2312	93	7.1	72	114
7440-43-9	Cadmium	9466	97.5	5.3	82	113
7440-70-2	Calcium	6347	98.1	5.8	81	116
7440-47-3	Chromium	9598	98.9	4.6	85	113
7440-48-4	Cobalt	6725	98.7	4.5	85	112
7440-50-8	Copper	7839	99.1	6	81	117
7439-89-6	Iron	5746	99.7	6.1	81	118
7439-92-1	Lead	10160	96.8	5.1	81	112
7439-93-2	Lithium	551	98.8	4.5	85	112
7439-95-4	Magnesium	6283	96.1	6.1	78	115
7439-96-5	Manganese	6732	99.1	4.9	84	114
7439-98-7	Molybdenum	4424	98.7	5.7	82	116
7440-02-0	Nickel	7412	98.1	4.9	83	113
7723-14-0	Phosphorus	189	103.1	3.8	92	114
7440-09-7	Potassium	6574	98.3	5.8	81	116
7782-49-2	Selenium	8862	94.5	5.6	78	111
7440-22-4	Silver	9105	97.3	5	82	112
7440-23-5	Sodium	5825	100.1	5.8	83	118
7440-24-6	Strontium	2573	98.5	5	83	114
7440-28-0	Thallium	6416	96.8	4.6	83	111
7440-31-5	Tin	2780	100.1	6.6	80	120
7440-32-6	Titanium	2107	98.2	5.2	83	114
7440-61-1	Uranium	109	97.4	5.2	82	113
7440-62-2	Vanadium	6934	98.3	5.4	82	114
7440-66-6	Zinc	7882	97.4	5	82	113

Table C-4. Method 6010 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7429-90-5	Aluminum	11532	100	4.8	86	115
7440-36-0	Antimony	10737	100.2	4.2	88	113
7440-38-2	Arsenic	14123	99.9	4.3	87	113
7440-39-3	Barium	14476	100.3	4.1	88	113
7440-41-7	Beryllium	11552	100.4	4	89	112
7440-69-9	Bismuth	147	95.8	3.2	86	105
7440-42-8	Boron	3871	98.8	4.8	85	113
7440-43-9	Cadmium	13922	100.8	4.1	88	113
7440-70-2	Calcium	11382	100	4.2	87	113
7440-47-3	Chromium	15027	101.1	3.9	90	113
7440-48-4	Cobalt	11824	101.2	4.2	89	114
7440-50-8	Copper	12910	100.2	4.6	86	114
7439-89-6	Iron	13797	100.7	4.7	87	115
7439-92-1	Lead	14391	99.3	4.4	86	113
7439-93-2	Lithium	938	100.7	5.3	85	117
7439-95-4	Magnesium	11423	98.8	4.8	85	113
7439-96-5	Manganese	12767	101.9	4.1	90	114
7439-98-7	Molybdenum	8251	101.1	4	89	113
7440-02-0	Nickel	12699	100.5	4.1	88	113
7440-05-3	Palladium	492	99.8	4	88	112
7723-14-0	Phosphorus	203	100.5	4.2	88	113
7440-09-7	Potassium	11006	99.9	4.7	86	114
7782-49-2	Selenium	13264	98.5	5.2	83	114
7440-21-3	Silicon	1525	100.6	6.1	82	119
7440-22-4	Silver	13770	99.1	5.1	84	115
7440-23-5	Sodium	10893	100.9	4.7	87	115
7440-24-6	Strontium	3782	101.3	3.8	90	113
7704-34-9	Sulfur	145	100.7	3.9	89	112
7440-28-0	Thallium	10063	99.5	4.7	85	114
7440-31-5	Tin	4502	101.3	4.4	88	115
7440-32-6	Titanium	5625	101.1	3.4	91	111
7440-61-1	Uranium	223	101.3	5.8	84	119

Table C-4. Method 6010 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7440-62-2	Vanadium	12032	100.2	3.6	90	111
7440-66-6	Zinc	13549	100.6	4.6	87	115

Table C-5. Method 6020 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7429-90-5	Aluminum	919	101	7.7	78	124
7440-36-0	Antimony	1911	98.2	8.7	72	124
7440-38-2	Arsenic	3686	99.8	6	82	118
7440-39-3	Barium	2598	100.6	5	86	116
7440-41-7	Beryllium	2457	100.3	6.6	80	120
7440-42-8	Boron	581	101.1	9	74	128
7440-43-9	Cadmium	2893	99.6	5.4	84	116
7440-70-2	Calcium	835	102.2	5.4	86	118
7440-47-3	Chromium	2420	100.8	6	83	119
7440-48-4	Cobalt	2005	99.7	5.1	84	115
7440-50-8	Copper	2548	101.3	5.8	84	119
7439-89-6	Iron	1131	102.7	7.1	81	124
7439-92-1	Lead	3228	101	5.7	84	118
7439-93-2	Lithium	162	97.8	7.5	75	120
7439-95-4	Magnesium	868	101.6	7.1	80	123
7439-96-5	Manganese	1830	100.3	5.1	85	116
7439-97-6	Mercury	226	99.9	8.8	74	126
7439-98-7	Molybdenum	1188	98.1	5.1	83	114
7440-02-0	Nickel	2617	101.4	5.8	84	119
7440-09-7	Potassium	803	102.3	5.7	85	119
7782-49-2	Selenium	3104	99.2	6.6	80	119
7440-22-4	Silver	2488	100.1	5.9	83	118
7440-23-5	Sodium	818	102.2	7.7	79	125
7440-24-6	Strontium	676	101.7	8.9	75	129

Table C-5. Method 6020 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7440-28-0	Thallium	2589	100.1	5.9	83	118
7440-29-1	Thorium	341	98.4	5.7	81	116
7440-31-5	Tin	886	101.3	6.6	82	121
7440-32-6	Titanium	512	100.2	5.7	83	117
7440-61-1	Uranium	833	101.1	6.1	83	120
7440-62-2	Vanadium	1677	99.1	5.7	82	116
7440-66-6	Zinc	2352	100.1	6.2	82	119

Table C-6. Method 6020 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7429-90-5	Aluminum	3145	100.6	5.4	84	117
7440-36-0	Antimony	5172	100.9	5.3	85	117
7440-38-2	Arsenic	6404	100.1	5.3	84	116
7440-39-3	Barium	4452	99.9	4.8	86	114
7440-41-7	Beryllium	4297	102	6.3	83	121
7440-42-8	Boron	1460	101.5	9.6	73	130
7440-43-9	Cadmium	5699	100.8	4.7	87	115
7440-70-2	Calcium	2085	102.3	5.2	87	118
7440-47-3	Chromium	5569	100.6	5.1	85	116
7440-48-4	Cobalt	3885	100.7	4.7	86	115
7440-50-8	Copper	5092	101.4	5.4	85	118
7439-89-6	Iron	3135	102.4	5.2	87	118
7439-92-1	Lead	6868	101.7	4.5	88	115
7439-93-2	Lithium	461	102.3	8	78	126
7439-95-4	Magnesium	2399	100.4	5.9	83	118
7439-96-5	Manganese	4330	101.1	4.7	87	115
7439-97-6	Mercury	328	97.2	9	70	124
7439-98-7	Molybdenum	2908	99.3	5.4	83	115
7440-02-0	Nickel	5095	100.8	5.3	85	117

Table C-6. Method 6020 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7440-09-7	Potassium	2154	101.2	4.7	87	115
7782-49-2	Selenium	5797	100.1	6.7	80	120
7440-22-4	Silver	4956	100.8	5.1	85	116
7440-23-5	Sodium	2313	100.7	5.3	85	117
7440-24-6	Strontium	1170	99.9	5.9	82	118
7440-28-0	Thallium	5352	99.3	5.6	82	116
7440-29-1	Thorium	313	103.7	5.7	87	121
7440-31-5	Tin	1509	100.6	4.8	86	115
7440-32-6	Titanium	1538	98.6	5.3	83	115
7440-33-7	Tungsten	130	103.5	6.2	85	122
7440-61-1	Uranium	1860	103.3	5.4	87	120
7440-62-2	Vanadium	3375	100.5	5	86	115
7440-66-6	Zinc	4253	101	6	83	119

Table C-7. Method 6850 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
14797-73-0	Perchlorate	575	102.5	6.1	84	121

Table C-8. Method 6850 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
14797-73-0	Perchlorate	790	101.6	5.8	84	119

Table C-9. Method 7196 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
18540-29-9	Hexavalent Chromium [Cr (VI)]	2688	96.7	4.3	84	110

Table C-10. Method 7196 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
18540-29-9	Hexavalent Chromium [Cr (VI)]	1576	100.5	3.6	90	111

Table C-11. Method 7470 - 7471 Series Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7439-97-6	Mercury	6471	102	7.5	80	124

Table C-12. Method 7470 - 7471 Series Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7439-97-6	Mercury	10530	100.5	6.3	82	119

Table C-13. Method 8015 (MOD) Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
460-00-4	4-Bromofluorobenzene	1263	100.7	11.1	67	134
303-04	Diesel Range Organics (DRO)	2184	85.2	15.7	38	132
307-27	Gasoline Range Organics (GRO)	1134	100.3	7.2	79	122
307-51	Motor Oil	658	72.2	11.2	39	106
84-15-1	o-Terphenyl	314	87.4	14.1	45	130

Table C-14. Method 8015 (MOD) Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
460-00-4	4-Bromofluorobenzene	756	101	10.8	69	133
303-04	Diesel Range Organics (DRO)	1757	83.7	16	36	132
307-27	Gasoline Range Organics (GRO)	971	99.9	7.3	78	122
307-51	Motor Oil	573	76.9	12.1	41	113
84-15-1	o-Terphenyl	299	90.5	11.4	56	125
630-02-4	Octacosane	130	101.1	13.8	60	142

Table C-15. Method 8081 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
789-02-6	2,4'-DDT	110	100.1	11.9	64	136
53-19-0	2,4-DDD	111	102.8	9.2	75	130
3424-82-6	2,4-DDE	111	102.2	9.5	74	131
72-54-8	4,4'-DDD	2995	97.7	13.9	56	139
72-55-9	4,4'-DDE	2938	95.3	13	56	134
50-29-3	4,4'-DDT	2470	95.8	15.1	50	141
309-00-2	Aldrin	2985	90.5	15.2	45	136
319-84-6	alpha-BHC	3021	90.9	15.3	45	137
5103-71-9	alpha-Chlordane	2681	93.7	13.2	54	133
319-85-7	beta-BHC	2989	93.1	14.3	50	136
57-74-9	Chlordane	229	95.7	17.7	43	149
319-86-8	delta-BHC	2943	93.3	15.3	47	139
60-57-1	Dieldrin	2987	95.7	13.4	56	136
959-98-8	Endosulfan I	984	92.2	13.2	53	132
33213-65-9	Endosulfan II	2913	93.1	13.5	53	134
1031-07-8	Endosulfan sulfate	2954	95.9	13.5	55	136
72-20-8	Endrin	3076	98.1	13.9	57	140
7421-93-4	Endrin Aldehyde	3004	86	17	35	137
53494-70-5	Endrin Ketone	2953	95.5	13.5	55	136
58-89-9	gamma-BHC [Lindane]	3153	92.1	14.4	49	135
5566-34-7	gamma-Chlordane	2749	94.3	13.7	53	135
76-44-8	Heptachlor	3144	91.6	14.9	47	136
1024-57-3	Heptachlor Epoxide	3093	93.9	13.9	52	136
118-74-1	Hexachlorobenzene	319	91.6	11.4	57	126
72-43-5	Methoxychlor	3021	97.6	15.2	52	143
2385-85-5	Mirex	303	96.4	10.6	65	128
877-09-8	Tetrachloro-m-xylene	1482	85.3	14.6	42	129
8001-35-2	Toxaphene	532	86.7	17.9	33	141

Table C-16. Method 8081 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
72-54-8	4,4'-DDD	3112	99.6	14.4	56	143
72-55-9	4,4'-DDE	3062	96	12.9	57	135
50-29-3	4,4'-DDT	2681	97	15.3	51	143
309-00-2	Aldrin	3021	89.5	14.7	45	134
319-84-6	alpha-BHC	3070	95.8	13.9	54	138
5103-71-9	alpha-Chlordane	2736	94.3	11.6	60	129
319-85-7	beta-BHC	3068	96.3	13.3	56	136
57-74-9	Chlordane	150	101.2	13	62	140
319-86-8	delta-BHC	3035	97.2	15	52	142
60-57-1	Dieldrin	3078	98	12.6	60	136
959-98-8	Endosulfan I	968	93.8	10.7	62	126
33213-65-9	Endosulfan II	3047	93.4	13.7	52	135
1031-07-8	Endosulfan sulfate	3013	97.2	11.9	62	133
72-20-8	Endrin	3635	98.7	13	60	138
7421-93-4	Endrin aldehyde	3018	91.1	13.5	51	132
53494-70-5	Endrin Ketone	2908	95.9	12.6	58	134
58-89-9	gamma-BHC [Lindane]	3693	96.4	12.5	59	134
5566-34-7	gamma-Chlordane	3008	95.8	13.2	56	136
76-44-8	Heptachlor	3597	91.9	12.8	54	130
1024-57-3	Heptachlor Epoxide	3574	96.9	12.1	61	133
118-74-1	Hexachlorobenzene	134	82.1	18.1	27.8	136.5
72-43-5	Methoxychlor	3569	99	15.2	54	145
2385-85-5	Mirex	340	88.8	12.6	51	127
877-09-8	Tetrachloro-m-xylene	1510	84.1	13.3	44	124
8001-35-2	Toxaphene	421	83.9	16.8	33	134

Table C-17. Method 8082 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
12674-11-2	Aroclor 1016	6847	90.1	14.5	47	134
11097-69-1	Aroclor 1254	406	101.2	11.4	67	135
11096-82-5	Aroclor 1260	7975	96.6	14.4	53	140
877-09-8	Tetrachloro-m-xylene	2379	86.7	14.4	44	130

Table C-18. Method 8082 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
12674-11-2	Aroclor 1016	3356	87.1	13.8	46	129
11097-69-1	Aroclor 1254	184	80.1	15.4	34	127
11096-82-5	Aroclor 1260	3538	89.4	14.8	45	134

Table C-19. Method 8141 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
86-50-0	Azinphos-methyl	325	96.7	19.6	38	156
35400-43-2	Bolstar [Sulprofos]	270	93.5	15.1	48	139
786-19-6	Carbophenothion	237	96.6	12.5	59	134
2921-88-2	Chlorpyrifos	333	93.3	15.5	47	140
56-72-4	Coumaphos	321	98.4	20.5	37	160
8065-48-3	Demeton	254	80.2	12.4	43	117
333-41-5	Diazinon	328	87.9	15.2	42	134
62-73-7	Dichlorvos [DDVP]	322	90.6	17.2	39	142
60-51-5	Dimethoate	264	77.5	20.6	16	139
298-04-4	Disulfoton	332	86	19.5	28	145
2104-64-5	EPN	300	90.6	15.5	44	137
563-12-2	Ethion	160	99.3	13.5	59	140
13194-48-4	Ethoprop	325	87.8	13.5	47	128
52-85-7	Fampphur	192	90.6	14.6	47	134

Table C-19. Method 8141 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
115-90-2	Fensulfothion	324	87.1	20	27	147
55-38-9	Fenthion	325	88.7	14.9	44	134
121-75-5	Malathion	322	91.2	15.2	46	137
298-00-0	methyl Parathion	330	93.6	14.8	49	138
126-68-1	O,O,O-Triethyl phosphorothioate	186	79.8	13.3	40	120
56-38-2	Parathion	313	94.3	14.9	50	139
298-02-2	Phorate	330	82.6	19.8	23	142
299-84-3	Ronnel	328	91.6	15.5	45	138
122-34-9	Simazine	120	93	16.3	44	142
22248-79-9	Stirophos [Tetrachlorovinphos, Gardona]	153	91.2	16.3	42	140
3689-24-5	Tetraethyl dithiopyrophosphate [Sulfotep]	238	89	12.2	52	126
297-97-2	Thionazine	192	83.5	13.3	44	124
34643-46-4	Tokuthion [Protothiofos]	320	90.7	15.1	45	136
327-98-0	Trichloronate	326	88.3	17.2	37	140

Table C-20. Method 8141 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
1912-24-9	Atrazine	262	82.1	12.5	45	120
86-50-0	Azinphos-methyl	689	88.9	15.4	43	135
35400-43-2	Bolstar [Sulprofos]	561	91.2	14.6	47	135
786-19-6	Carbophenothion	418	94.4	14.1	52	137
2921-88-2	Chlorpyrifos	644	90	14.2	47	133
56-72-4	Coumaphos	684	89.9	15.1	45	135
8065-48-3	Demeton	591	76.2	17.1	25	128
126-75-0	Demeton-S	134	91.4	23.6	21	162
333-41-5	Diazinon	684	86	14.4	43	129
62-73-7	Dichlorvos [DDVP]	682	88.3	16.4	39	138

Table C-20. Method 8141 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
60-51-5	Dimethoate	597	75.2	16.5	26	125
298-04-4	Disulfoton	753	85.1	16.3	36	134
2104-64-5	EPN	623	90	14.3	47	133
563-12-2	Ethion	345	93.3	17.1	42	145
13194-48-4	Ethoprop	620	88.8	12.2	52	125
55-38-9	Fenthion	712	89.7	15.8	42	137
121-75-5	Malathion	635	87.8	14.6	44	132
150-50-5	Merphos	704	79.6	17.8	26	133
298-00-0	Methyl parathion	795	91.9	14.2	49	134
126-68-1	O,O,O-Triethyl phosphorothioate	295	94.2	17.5	42	147
56-38-2	Parathion	713	92.9	13.7	52	134
298-02-2	Phorate	675	79.8	19	23	139
139-40-2	Propazine [Milogard]	241	86.7	11.8	51	122
299-84-3	Ronnel	740	87.1	15.1	42	133
22248-79-9	Stirophos [Tetrachlorovinphos, Gardona]	310	94.8	15.8	48	142
3689-24-5	Tetraethyl dithiopyrophosphate [Sulfotep]	584	86.5	13.1	47	126
297-97-2	Thionazine	366	85.1	13.4	45	125
34643-46-4	Tokuthion [Protothiofos]	696	87.8	14.8	43	132
327-98-0	Trichloronate	556	82.8	18.2	28	137

Table C-21. Method 8151 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
93-76-5	2,4,5-T	1106	84.6	17.7	31	138
93-72-1	2,4,5-TP [Silvex]	1179	86.1	14.3	43	129
94-75-7	2,4-D	1256	86	19.3	28	144
94-82-6	2,4-DB	1030	88.2	17.9	34	142
19719-28-9	2,4-Dichlorophenylacetic Acid	1041	74	15.9	27	122
100-02-7	4-Nitrophenol	208	76.7	20	17	137

Table C-21. Method 8151 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
50594-66-6	Acifluorfen	206	79.8	18	26	134
1861-32-1	Dacthal (DCPA)	147	72.5	15.6	26	119
1918-00-9	Dicamba	1070	85.2	15.7	38	132
120-36-5	Dichloroprop	1033	91.4	21	28	155
94-74-6	MCPA	935	81.5	17.8	28	135
93-65-2	MCPP	807	88.7	18	35	143

Table C-22. Method 8151 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
93-76-5	2,4,5-T	1758	94.8	17.5	42	147
93-72-1	2,4,5-TP [Silvex]	2289	92.9	13.8	51	134
94-75-7	2,4-D	2396	98.4	17.7	45	152
94-82-6	2,4-DB	1427	94.1	19.7	35	153
19719-28-9	2,4-Dichlorophenylacetic Acid	905	85	17.7	32	138
100-02-7	4-Nitrophenol	245	89.8	17.4	38	142
50594-66-6	Acifluorfen	262	95.5	16.2	47	144
133-90-4	Chloramben	230	79.5	18.5	24	135
1861-32-1	Dacthal (DCPA)	160	76.2	13.6	36	117
75-99-0	Dalapon	1220	79	20	19	139
1918-00-9	Dicamba	1434	95.3	15.2	50	141
120-36-5	Dichloroprop	1404	102	18.8	46	159
94-74-6	MCPA	1284	89.2	18.2	35	144
93-65-2	MCPP	1137	95.2	20.7	33	157
7085-19-0	Mecoprop	126	97.4	21.2	34	161
87-86-5	Pentachlorophenol	1149	97.5	13.8	56	139

Table C-23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
630-20-6	1,1,1,2-Tetrachloroethane	11115	101.1	7.8	78	125
71-55-6	1,1,1-Trichloroethane	12156	101.6	9.4	73	130
79-34-5	1,1,2,2-Tetrachloroethane	11670	97	8.9	70	124
79-00-5	1,1,2-Trichloroethane	11772	99.7	7.2	78	121
76-13-1	1,1,2-Trifluoro-1,2,2-trichloroethane [Freon-113]	9760	100.8	11.7	66	136
75-34-3	1,1-Dichloroethane	11856	100.4	8.1	76	125
75-35-4	1,1-Dichloroethene	12352	100.3	10.1	70	131
563-58-6	1,1-Dichloropropene	10793	100.5	8.3	76	125
87-61-6	1,2,3-Trichlorobenzene	10572	97.8	10.6	66	130
96-18-4	1,2,3-Trichloropropane	10925	99.1	8.8	73	125
526-73-8	1,2,3-Trimethylbenzene	1948	99.8	6	82	118
120-82-1	1,2,4-Trichlorobenzene	10980	98	10.4	67	129
95-63-6	1,2,4-Trimethylbenzene	11085	98.7	7.9	75	123
96-12-8	1,2-D bromo-3-chloropropane	11380	96.6	11.7	61	132
106-93-4	1,2-D bromoethane	11408	100.1	7.3	78	122
95-50-1	1,2-Dichlorobenzene	11785	99.1	7.2	78	121
107-06-2	1,2-Dichloroethane	12328	100.5	9.2	73	128
17060-07-0	1,2-Dichloroethane-d4	5951	103.1	10.8	71	136
540-59-0	1,2-Dichloroethene	7748	99.9	7.3	78	122
78-87-5	1,2-Dichloropropane	12145	99.5	7.8	76	123
354-23-4	1,2-Dichlorotrifluoroethane [Freon 123a]	1269	97.8	11.3	64	132
108-70-3	1,3,5-Trichlorobenzene	4723	99.4	9.6	71	128
108-67-8	1,3,5-Trimethylbenzene	11080	98.4	8.4	73	124
541-73-1	1,3-Dichlorobenzene	11619	98.9	7.4	77	121
142-28-9	1,3-Dichloropropane	10713	99.1	7.3	77	121
542-75-6	1,3-Dichloropropene	3714	101.6	8.1	77	126
106-46-7	1,4-Dichlorobenzene	11848	97.5	7.6	75	120
105-05-5	1,4-Diethylbenzene	1896	96.6	5.9	79	114
123-91-1	1,4-Dioxane	7698	96.4	13.7	55	138
544-10-5	1-Chlorohexane	2543	100.4	9.8	71	130
594-20-7	2,2-Dichloropropane	10703	99.7	11.1	67	133

Table C-23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
78-93-3	2-Butanone [MEK]	11514	99.6	16.3	51	148
126-99-8	2-Chloro-1,3-butadiene	6667	99	11.3	65	133
110-75-8	2-Chloroethyl vinyl ether	6957	96.1	17.6	43	149
95-49-8	2-Chlorotoluene	10838	98.5	7.9	75	122
591-78-6	2-Hexanone	11004	99.1	15.4	53	145
79-46-9	2-Nitropropane	4969	98.3	17.1	47	150
67-63-0	2-Propanol [Isopropyl alcohol]	1696	99.8	13.4	60	140
460-00-4	4-Bromofluorobenzene	6267	98.9	6.8	79	119
106-43-4	4-Chlorotoluene	10785	98.3	8.6	72	124
108-10-1	4-Methyl-2-pentanone [MIBK]	11364	99.6	11.6	65	135
67-64-1	Acetone	11089	99.6	21.4	36	164
75-05-8	Acetonitrile	5697	98.5	14.8	54	143
107-02-8	Acrolein [Propenal]	7528	101.1	18	47	155
107-13-1	Acrylonitrile	8293	99.7	11.4	65	134
107-05-1	Allyl chloride	6908	101.1	11.2	68	135
71-43-2	Benzene	12853	99.2	7.4	77	121
100-44-7	Benzyl chloride	2743	92.1	9.4	64	120
108-86-1	Bromobenzene	10974	99.3	7.3	78	121
74-97-5	Bromochloromethane	11023	101.4	7.8	78	125
75-27-4	Bromodichloromethane	11850	101	8.5	75	127
75-25-2	Bromoform	11890	99.1	10.8	67	132
74-83-9	Bromomethane	11416	98.3	15	53	143
75-15-0	Carbon disulfide	11132	97.9	11.5	63	132
56-23-5	Carbon tetrachloride	12090	102.3	10.7	70	135
108-90-7	Chlorobenzene	12382	99.7	6.9	79	120
124-48-1	Chlorodibromomethane	11852	100.2	8.7	74	126
75-00-3	Chloroethane	11444	98.8	13.3	59	139
67-66-3	Chloroform	12344	100.3	7.6	78	123
74-87-3	Chloromethane	11876	93.3	14.3	50	136
156-59-2	cis-1,2-Dichloroethene	11645	99.9	7.6	77	123
10061-01-5	cis-1,3-Dichloropropene	11805	99.8	8.7	74	126
1476-11-5	cis-1,4-Dichloro-2-butene	977	106	12.4	69	143

Table C-23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
110-82-7	Cyclohexane	8827	98.9	10.6	67	131
108-94-1	Cyclohexanone	3764	93.2	20.9	30	156
1868-53-7	Dibromofluoromethane	2142	98.1	6.8	78	119
74-95-3	Dibromomethane	10913	101.1	7.9	78	125
75-71-8	Dichlorodifluoromethane [Freon-12]	11467	88.9	20.1	29	149
75-43-4	Dichlorofluoromethane	717	100.8	18	47	155
60-29-7	Diethyl ether	6283	99.6	9.6	71	129
108-20-3	Diisopropyl ether	8542	98.3	9.7	69	127
64-17-5	Ethanol	3958	102.2	18.9	45	159
141-78-6	Ethyl acetate	4516	95.4	14.5	52	139
97-63-2	Ethyl methacrylate	7075	98.9	9.9	69	129
637-92-3	Ethyl tert-butyl ether	7514	98.9	9.1	72	126
100-41-4	Ethylbenzene	12427	99.1	7.7	76	122
462-06-6	Fluorobenzene	689	97.3	5.4	81	114
142-82-5	Heptane	5420	93.4	14.9	49	138
87-68-3	Hexachlorobutadiene	10264	98.1	12.4	61	135
67-72-1	Hexachloroethane	3265	102.5	10.1	72	133
110-54-3	Hexane	7116	93.6	16.1	45	142
74-88-4	Iodomethane	9457	100.9	10.1	71	131
78-83-1	Isobutyl alcohol	6162	97.5	12.6	60	135
108-21-4	Isopropyl acetate [Acetic acid]	2885	94.2	12.2	58	131
98-82-8	Isopropylbenzene	11596	100.8	11.1	68	134
179601-23-1	m/p-Xylene [3/4-Xylene]	10612	100.4	7.7	77	124
126-98-7	Methacrylonitrile	6736	99.2	11.1	66	132
79-20-9	Methyl acetate	8320	98.7	15.2	53	144
80-62-6	Methyl methacrylate	7050	98.4	11.9	63	134
1634-04-4	Methyl tert-butyl ether [MTBE]	11253	98.9	8.7	73	125
108-87-2	Methylcyclohexane	8565	99.4	11.2	66	133
75-09-2	Methylene chloride	12024	98.9	9.7	70	128
123-86-4	n-Butyl acetate	2981	95.1	11	62	128
71-36-3	n-Butyl alcohol	4800	92.9	12.6	55	131

Table C-23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
104-51-8	n-Butylbenzene	10921	98.7	9.7	70	128
103-65-1	n-Propylbenzene	10947	98.9	8.8	73	125
91-20-3	Naphthalene	10602	95.6	11.2	62	129
95-47-6	o-Xylene	11940	100	7.7	77	123
99-87-6	p-Isopropyltoluene [p-Cymene]	10953	100.3	9	73	127
76-01-7	Pentachloroethane	5957	102	11.1	69	135
107-12-0	Propionitrile [Ethyl cyanide]	6734	101	11.1	68	134
135-98-8	sec-Butylbenzene	10960	99	8.8	73	126
100-42-5	Styrene	11809	100.2	8	76	124
994-05-8	tert-Amyl methyl ether [TAME]	7153	99.8	8.9	73	126
75-65-0	tert-Butyl alcohol	7492	100.5	10.7	68	133
98-06-6	tert-Buty benzene	10974	98.8	8.6	73	125
127-18-4	Tetrachloroethene	12091	100.5	9.2	73	128
109-99-9	Tetrahydrofuran	8039	98	12.4	61	135
108-88-3	Toluene	12499	99.3	7.3	77	121
2037-26-5	Toluene-d8	6232	100.7	5.2	85	116
156-60-5	trans-1,2-Dichloroethene	11849	99.2	8.6	74	125
10061-02-6	trans-1,3-Dichloropropene	11805	100.9	9.8	71	130
110-57-6	trans-1,4-Dichloro-2-butene	8307	98.6	12.3	62	136
79-01-6	Trichloroethene	12440	100.2	7.6	77	123
75-69-4	Trichlorofluoromethane [Freon-11]	11530	101	13.1	62	140
108-05-4	Vinyl acetate	7260	100.3	16.9	50	151
75-01-4	Vinyl chloride	12129	95.6	13.2	56	135
1330-20-7	Xylenes [total]	8623	100.7	7.7	78	124

Table C-24. Method 8260 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
630-20-6	1,1,1,2-Tetrachloroethane	24511	101.1	7.6	78	124
71-55-6	1,1,1-Trichloroethane	28223	102.7	9.6	74	131

Table C-24. Method 8260 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
79-34-5	1,1,2,2-Tetrachloroethane	27450	96.4	8.3	71	121
79-00-5	1,1,2-Trichloroethane	27338	99.5	6.5	80	119
76-13-1	1,1,2-Trifluoro-1,2,2-trichloroethane [Freon-113]	21122	103	11.1	70	136
75-34-3	1,1-Dichloroethane	28154	101.3	8	77	125
75-35-4	1,1-Dichloroethene	29436	101	10	71	131
563-58-6	1,1-Dichloropropene	23631	102	7.8	79	125
87-61-6	1,2,3-Trichlorobenzene	24271	98.7	10.1	69	129
96-18-4	1,2,3-Trichloropropane	24525	97.5	8	73	122
526-73-8	1,2,3-Trimethylbenzene	2965	100.9	6.2	82	120
120-82-1	1,2,4-Trichlorobenzene	25290	99.8	10.1	69	130
95-63-6	1,2,4-Trimethylbenzene	27917	99.6	8	76	124
96-12-8	1,2-D bromo-3-chloropropane	24955	94.9	11.1	62	128
106-93-4	1,2-D bromoethane	29096	99	7.2	77	121
95-50-1	1,2-Dichlorobenzene	27583	99.4	6.5	80	119
107-06-2	1,2-Dichloroethane	32965	100.3	9.2	73	128
17060-07-0	1,2-Dichloroethane-d4	8673	99.5	6.1	81	118
540-59-0	1,2-Dichloroethene	18667	100.2	7.1	79	121
78-87-5	1,2-Dichloropropane	27787	100.1	7.2	78	122
354-23-4	1,2-Dichlorotrifluoroethane [Freon 123a]	3144	103.1	10.9	70	136
108-70-3	1,3,5-Trichlorobenzene	10037	102.1	9.2	75	130
108-67-8	1,3,5-Trimethylbenzene	27820	99.5	8.1	75	124
106-99-0	1,3-Butadiene	1202	100.6	19.2	43	158
541-73-1	1,3-Dichlorobenzene	26951	99.7	6.5	80	119
142-28-9	1,3-Dichloropropane	23811	99.1	6.5	80	119
542-75-6	1,3-Dichloropropene	9784	99.9	7.6	77	123
106-46-7	1,4-Dichlorobenzene	27715	98.3	6.5	79	118
105-05-5	1,4-Diethylbenzene	1980	98.4	6.4	79	118
123-91-1	1,4-Dioxane	17866	99	13.4	59	139
544-10-5	1-Chlorohexane	5790	99.6	8	76	124
540-84-1	2,2,4-Trimethylpentane [Isooctane]	5432	95.2	12.3	58	132

Table C-24. Method 8260 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
594-20-7	2,2-Dichloropropane	23775	99.7	13.2	60	139
75-85-4	2-Butanol	4332	92.7	9.1	66	120
78-93-3	2-Butanone [MEK]	26659	99.6	14.6	56	143
126-99-8	2-Chloro-1,3-butadiene	15673	100	11.7	65	135
110-75-8	2-Chloroethyl vinyl ether	18225	94.7	14.7	51	139
95-49-8	2-Chlorotoluene	23750	100	7.2	79	122
591-78-6	2-Hexanone	25368	97.9	13.5	57	139
91-57-6	2-Methylnaphthalene	3754	79.4	20.9	17	142
79-46-9	2-Nitropropane	10213	92.6	14.5	49	136
67-63-0	2-Propanol [Isopropyl alcohol]	2034	98.8	14.4	56	142
624-95-3	3,3-Dimethyl-1-butanol	6491	90.9	13.9	49	133
460-00-4	4-Bromofluorobenzene	9971	99.7	4.9	85	114
106-43-4	4-Chlorotoluene	23616	99.9	7.4	78	122
108-10-1	4-Methyl-2-pentanone [MIBK]	25796	98.5	10.6	67	130
67-64-1	Acetone	25006	99.5	20.1	39	160
75-05-8	Acetonitrile	13308	95.8	15.2	50	142
107-02-8	Acrolein [Propenal]	16380	96.8	19.3	39	155
107-13-1	Acrylonitrile	20173	99	11.9	63	135
107-05-1	Allyl chloride	15758	99	10.4	68	130
71-43-2	Benzene	34376	99.4	6.9	79	120
100-44-7	Benzyl chloride	10675	90.1	15.9	42	138
108-86-1	Bromobenzene	23762	99.7	6.7	80	120
74-97-5	Bromochloromethane	24356	100.8	7.5	78	123
75-27-4	Bromodichloromethane	26888	101.8	7.8	79	125
75-25-2	Bromoform	27675	97.8	10.8	66	130
74-83-9	Bromomethane	26717	97	14.7	53	141
75-15-0	Carbon disulfide	25719	98.8	11.5	64	133
56-23-5	Carbon tetrachloride	28870	103.8	10.7	72	136
108-90-7	Chlorobenzene	29802	100	6.1	82	118
124-48-1	Chlorodibromomethane	27424	100	8.5	74	126
75-45-6	Chlorodifluoromethane	7197	84.4	14.9	40	129
75-00-3	Chloroethane	27069	99	13	60	138

Table C-24. Method 8260 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
67-66-3	Chloroform	29373	101.1	7.5	79	124
74-87-3	Chloromethane	27697	94.5	15	50	139
156-59-2	cis-1,2-Dichloroethene	27935	100.1	7.5	78	123
10061-01-5	cis-1,3-Dichloropropene	27197	99.5	8	75	124
1476-11-5	cis-1,4-Dichloro-2-butene	1524	101.5	14.9	57	146
110-82-7	Cyclohexane	20438	100.4	10	71	130
1868-53-7	Dibromofluoromethane	5702	99.1	6.5	80	119
74-95-3	Dibromomethane	24473	101.1	7.3	79	123
75-71-8	Dichlorodifluoromethane [Freon-12]	25410	92	20.1	32	152
75-43-4	Dichlorofluoromethane	1504	101.5	9.8	72	131
60-29-7	Diethyl ether	17189	98.6	10.2	68	129
108-20-3	Diisopropyl ether	22989	97.5	10.3	67	128
64-17-5	Ethanol	9543	99.2	17.1	48	151
141-78-6	Ethyl acetate	9208	96.8	13.9	55	138
97-63-2	Ethyl methacrylate	16674	98.7	9	72	126
637-92-3	Ethyl tert-butyl ether	19841	98.3	9.4	70	127
100-41-4	Ethylbenzene	33325	99.8	7	79	121
462-06-6	Fluorobenzene	1373	97.9	6.1	80	116
142-82-5	Heptane	11878	94.4	15	49	140
87-68-3	Hexachlorobutadiene	23535	100.1	11.3	66	134
67-72-1	Hexachloroethane	8718	102.9	10.3	72	134
110-54-3	Hexane	15545	95.5	15.9	48	143
74-88-4	Iodomethane	20229	100	10.4	69	131
78-83-1	Isobutyl alcohol	14123	97.7	11.7	63	133
108-21-4	Isopropyl acetate [Acetic acid]	7216	97.8	11.6	63	133
98-82-8	Isopropylbenzene	28636	101.5	9.9	72	131
179601-23-1	m/p-Xylene [3/4-Xylene]	28168	100.5	6.9	80	121
126-98-7	Methacrylonitrile	15982	97.9	11.6	63	133
79-20-9	Methyl acetate	19698	96	13.2	56	136
80-62-6	Methyl methacrylate	16524	97.7	10.2	67	128
1634-04-4	Methyl tert-butyl ether [MTBE]	29660	97.3	8.8	71	124

Table C-24. Method 8260 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
108-87-2	Methylcyclohexane	20025	101.8	10.1	72	132
75-09-2	Methylene chloride	27659	99.4	8.3	74	124
123-86-4	n-Butyl acetate	7247	96.8	9.4	69	125
71-36-3	n-Butyl alcohol	10122	95.1	12	59	131
104-51-8	n-Butylbenzene	24088	101.1	8.8	75	128
109-60-4	n-Propyl acetate	602	100.8	8.3	76	126
103-65-1	n-Propylbenzene	24419	101	8.5	76	126
91-20-3	Naphthalene	27847	94.6	11.3	61	128
95-47-6	o-Xylene	31776	100	7.2	78	122
99-87-6	p-Isopropyltoluene [p-Cymene]	24335	102	8.5	77	127
76-01-7	Pentachloroethane	11688	101.1	10.7	69	133
109-66-0	Pentane	3915	74.8	19.7	16	134
107-12-0	Propionitrile [Ethyl cyanide]	15701	99.9	12	64	136
135-98-8	sec-Butylbenzene	24191	101.1	8.1	77	126
100-42-5	Styrene	26985	100.5	7.6	78	123
994-05-8	tert-Amyl methyl ether [TAME]	19726	98.1	10.1	68	128
75-65-0	tert-Butyl alcohol	21112	98.6	10.1	68	129
762-75-4	tert-Butyl formate	6651	98.1	11.1	65	132
98-06-6	tert-Buty benzene	23919	101	7.7	78	124
127-18-4	Tetrachloroethene	29017	101.3	9.3	74	129
109-99-9	Tetrahydrofuran	18021	95	12.8	57	133
108-88-3	Toluene	33510	100.1	6.8	80	121
2037-26-5	Toluene-d8	9809	100.4	3.8	89	112
156-60-5	trans-1,2-Dichloroethene	27663	99.5	8.2	75	124
10061-02-6	trans-1,3-Dichloropropene	27134	100	8.9	73	127
110-57-6	trans-1,4-Dichloro-2-butene	19320	91.5	16.1	43	140
79-01-6	Trichloroethene	30150	101.1	7.3	79	123
75-69-4	Trichlorofluoromethane [Freon-11]	26108	103	12.8	65	141
108-05-4	Vinyl acetate	18941	100.2	15.3	54	146
75-01-4	Vinyl chloride	29472	97.4	13.2	58	137
1330-20-7	Xylenes [total]	23426	100.1	7	79	121

Table C-25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
92-52-4	1,1-Biphenyl	1645	78.5	13	40	117
95-94-3	1,2,4,5-Tetrachlorobenzene	1810	77.8	13.7	37	119
120-82-1	1,2,4-Trichlorobenzene	3577	75.7	13.9	34	118
95-50-1	1,2-Dichlorobenzene	3352	74.6	14	33	117
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	203	79.4	11.9	44	115
122-66-7	1,2-Diphenylhydrazine [Azobenzene]	2039	83	13.9	41	125
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	154	89.2	10.7	57	121
541-73-1	1,3-Dichlorobenzene	3288	72.6	14.1	30	115
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	598	84.6	14	43	127
106-46-7	1,4-Dichlorobenzene	3793	73.1	13.9	31	115
100-25-4	1,4-Dinitrobenzene	248	84.4	15.7	37	132
130-15-4	1,4-Naphthoquinone	150	81.2	8.8	55	108
90-13-1	1-Chloronaphthalene	119	81.1	11.1	48	115
90-12-0	1-Methylnaphthalene	3004	79.2	13.2	40	119
58-90-2	2,3,4,6-Tetrachlorophenol	1724	84.7	13.6	44	125
935-95-5	2,3,5,6-Tetrachlorophenol	227	75.9	11.9	40	112
608-27-5	2,3-Dichloroaniline	108	82.4	13	44	121
95-95-4	2,4,5-Trichlorophenol	4014	82.6	13.7	41	124
118-79-6	2,4,6-Tribromophenol	2930	85.7	15.4	39	132
88-06-2	2,4,6-Trichlorophenol	4183	82.1	14.5	39	126
120-83-2	2,4-Dichlorophenol	3794	80.9	13.7	40	122
105-67-9	2,4-Dimethylphenol	3886	78.4	16.2	30	127
121-14-2	2,4-Dinitrotoluene	4075	86.8	12.9	48	126
87-65-0	2,6-Dichlorophenol	1364	79.2	12.6	41	117
606-20-2	2,6-Dinitrotoluene	3706	85	13	46	124
53-96-3	2-Acetylaminofluorene	175	94	13.3	54	134
91-58-7	2-Chloronaphthalene	3569	77.5	12.1	41	114
95-57-8	2-Chlorophenol	3977	77.3	14.5	34	121
321-60-8	2-Fluorobiphenyl	3191	79.5	11.8	44	115
367-12-4	2-Fluorophenol	3008	75.2	13.3	35	115
91-57-6	2-Methylnaphthalene	5059	80.1	14	38	122

Table C-25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
95-48-7	2-Methylphenol (o-Cresol)	4016	77	14.9	32	122
88-74-4	2-Nitroaniline	3639	85.4	13.8	44	127
119-75-5	2-Nitrodiphenylamine	279	88.1	11.6	53	123
88-75-5	2-Nitrophenol	3804	79.6	14.5	36	123
109-06-8	2-Picoline [2-Methylpyridine]	181	64.5	12.7	27	103
91-94-1	3,3'-Dichlorobenzidine	3521	71.3	16.5	22	121
56-49-5	3-Methylcholanthrene	188	95.1	13	56	134
99-09-2	3-Nitroaniline	3454	75.9	14.3	33	119
65794-96-9	3/4-Methylphenol [m/p-Cresol]	2900	76.5	14.1	34	119
534-52-1	4,6-Dinitro-2-methylphenol	3739	80.7	17.2	29	132
101-55-3	4-Bromophenyl phenyl ether	3708	85.1	13	46	124
59-50-7	4-Chloro-3-methylphenol	3880	83.3	12.9	45	122
106-47-8	4-Chloroaniline [p-Chloroanlinie]	3435	61.3	14.9	17	106
7005-72-3	4-Chlorophenyl phenyl ether	3673	83	12.7	45	121
106-44-5	4-Methylphenol [p-Cresol]	1555	84.1	14.1	42	126
100-02-7	4-Nitrophenol	3976	80.6	17	30	132
99-55-8	5-Nitro-o-toluidine [2-Amino-4-nitrotoluene]	187	69.8	15.8	23	117
57-97-6	7,12-Dimethy benz(a)-anthracene	338	96.2	15.3	50	142
83-32-9	Acenaphthene	5300	81.3	13.7	40	123
208-96-8	Acenaphthylene	5194	81.8	16.8	32	132
98-86-2	Acetophenone	2101	73.9	13.6	33	115
120-12-7	Anthracene	5250	85.2	12.7	47	123
1912-24-9	Atrazine	1428	87.1	13.4	47	127
103-33-3	Azobenzene	378	82.1	14.2	39	125
56-55-3	Benz(a)anthracene	5385	87.4	12.9	49	126
50-32-8	Benzo(a)pyrene	5500	86.9	13.9	45	129
205-99-2	Benzo(b)fluoranthene	5323	88.3	14.5	45	132
191-24-2	Benzo(g,h,i)perylene	5263	88.5	15.1	43	134
207-08-9	Benzo(k)fluoranthene	5386	89.6	14.2	47	132
100-51-6	Benzyl alcohol	2895	75.7	15.6	29	122

Table C-25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
111-91-1	bis(2-Chloroethoxy)methane	3705	78.4	14.2	36	121
111-44-4	Bis(2-chloroethyl) ether	3711	75.4	14.9	31	120
39638-32-9	bis(2-Chloroisopropyl) ether	769	82	16.3	33	131
117-81-7	Bis(2-ethylhexyl) phthalate	4018	91.9	13.7	51	133
103-23-1	bis(2-Ethylhexyl)adipate	156	90.8	10.1	61	121
85-68-7	Butyl benzyl phthalate	3956	90.3	14	48	132
105-60-2	Caprolactam	1203	81.3	11.9	46	117
86-74-8	Carbazole	3095	86.3	12	50	123
510-15-6	Chlorobenzilate	172	99.7	16.9	49	150
218-01-9	Chrysene	5395	87.1	12.2	50	124
84-74-2	Di-n-butyl phthalate	4041	89.4	12.8	51	128
117-84-0	Di-n-octyl phthalate	3985	92.4	16	45	140
2303-16-4	Diallate [cis or trans]	173	93.7	12.7	56	132
53-70-3	Dibenzo(a,h)anthracene	5393	89.5	14.7	45	134
132-64-9	Dibenzofuran	3749	81.5	12.7	44	120
84-66-2	Diethyl phthalate	4012	87.2	12.3	50	124
60-51-5	Dimethoate	137	68	13.3	28	108
131-11-3	Dimethyl phthalate	4023	85.9	12.6	48	124
60-11-7	Dimethylaminoazobenzene	177	98.7	11.6	64	134
88-85-7	Dinoseb	123	67.3	17.1	16	119
101-84-8	Diphenyl ether	114	95.6	6	78	114
122-39-4	Diphenylamine	854	79.5	10.6	48	111
62-50-0	Ethyl methanesulfonate	174	85.1	16.9	34	136
206-44-0	Fluoranthene	5340	88.3	12.9	50	127
86-73-7	Fluorene	5150	84.2	13.8	43	125
118-74-1	Hexachlorobenzene	4138	83.5	13	45	122
87-68-3	Hexachlorobutadiene	4003	77.3	15.3	32	123
67-72-1	Hexachloroethane	4049	72.2	14.9	28	117
1888-71-7	Hexachloropropene	259	81.9	16.7	32	132
95-13-6	Indene	188	85.3	8.9	59	112
193-39-5	Indeno(1,2,3-cd)pyrene	5367	89.3	14.7	45	133
465-73-6	Isodrin	167	93.8	12.8	56	132

Table C-25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
78-59-1	Isophorone	3787	75.9	15.2	30	122
120-58-1	Isosafrole	174	89.5	15.4	43	136
66-27-3	Methyl methanesulfonate	150	77.9	13.1	38	117
100-75-4	n-Nitorosopiperidine	232	89.4	9.8	60	119
924-16-3	n-Nitrosodi-n-butylamine	236	91.7	10.8	59	124
621-64-7	n-Nitrosodi-n-propylamine	3857	78.2	13.9	36	120
55-18-5	n-nitrosodiethylamine	421	82.1	13.8	41	124
62-75-9	n-Nitrosodimethylamine	3170	71.6	16.2	23	120
86-30-6	n-Nitrosodiphenylamine	2968	82.7	14.8	38	127
10595-95-6	n-Nitrosomethylethylamine	265	78.7	14.9	34	123
59-89-2	n-Nitrosomorpholine	172	91.3	13.8	50	133
930-55-2	n-Nitrosopyrrolidine	326	85.5	13.6	45	126
91-20-3	Naphthalene	5342	78.8	14.7	35	123
98-95-3	Nitrobenzene	4103	77.8	14.7	34	122
4165-60-0	Nitrobenzene-d5	3226	79.3	14.2	37	122
56-57-5	Nitroquinoline-1-oxide	177	91.3	24.5	18	165
126-68-1	O,O,O-Triethyl phosphorothioate	138	91.6	10.8	59	124
593-45-3	Octadecane	113	87.4	14.5	44	131
608-93-5	Pentachlorobenzene	346	89.7	11.8	54	125
76-01-7	Pentachloroethane	131	70.4	10.6	39	102
87-86-5	Pentachlorophenol	4161	78.7	18	25	133
82-68-8	Pentchloronitrobenzene	579	86.1	16	38	134
62-44-2	Phenacetin	185	95	12.5	57	133
85-01-8	Phenanthrene	5259	85.4	12	50	121
108-95-2	Phenol	4029	77.3	14.4	34	121
4165-62-2	Phenol-d5	1016	77.4	14.9	33	122
23950-58-5	Pronamide	179	93	12.4	56	130
129-00-0	Pyrene	5518	87.2	13.3	47	127
91-22-5	Quinoline	219	90	11.9	54	126
94-59-7	Safrole	176	87.8	13.6	47	129
1718-51-0	Terphenyl-d14	3111	90.5	12.3	54	127

Table C-25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
3689-24-5	Tetraethyl dithiopyrophosphate [Sulfotep]	136	94.4	14	52	137
297-97-2	Thionazine	139	94.6	10.7	62	127

Table C-26. Method 8270 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
92-52-4	1,1-Biphenyl	2247	82.1	11.1	49	115
95-94-3	1,2,4,5-Tetrachlorobenzene	2326	77.9	14.5	35	121
120-82-1	1,2,4-Trichlorobenzene	4716	72.6	14.5	29	116
95-50-1	1,2-Dichlorobenzene	4442	71.4	13.3	32	111
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	112	83.9	8.3	59	109
122-66-7	1,2-Diphenylhydrazine [Azobenzene]	2244	85.4	12.2	49	122
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	241	89.1	16	41	137
541-73-1	1,3-Dichlorobenzene	4375	68.6	13.6	28	110
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	601	88.2	13.1	49	128
106-46-7	1,4-Dichlorobenzene	5433	70.4	13.9	29	112
90-13-1	1-Chloronaphthalene	211	84.5	8.8	58	111
90-12-0	1-Methylnaphthalene	3742	80	13.1	41	119
134-32-7	1-Naphthylamine	258	73.7	16.6	24	124
58-90-2	2,3,4,6-Tetrachlorophenol	2293	89	13	50	128
935-95-5	2,3,5,6-Tetrachlorophenol	266	85.6	11.7	50	121
608-27-5	2,3-Dichloroaniline	150	99.2	9.8	70	129
95-95-4	2,4,5-Trichlorophenol	5707	88.1	11.8	53	123
118-79-6	2,4,6-Tribromophenol	2059	91.5	16	43	140
88-06-2	2,4,6-Trichlorophenol	6136	87.2	12.4	50	125
120-83-2	2,4-Dichlorophenol	5330	84	12.2	47	121
105-67-9	2,4-Dimethylphenol	5298	77.5	15.6	31	124
51-28-5	2,4-Dinitrophenol	5127	82.9	20	23	143
121-14-2	2,4-Dinitrotoluene	6032	92.3	11.8	57	128

Table C-26. Method 8270 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
87-65-0	2,6-Dichlorophenol	1583	84	11.4	50	118
606-20-2	2,6-Dinitrotoluene	5107	90.7	11.2	57	124
53-96-3	2-Acetylaminofluorene	228	98.9	12.9	60	138
91-58-7	2-Chloronaphthalene	5084	78	12.8	40	116
95-57-8	2-Chlorophenol	5571	77.5	13.2	38	117
93951-73-6	2-Chlorophenol-d4	119	79.9	8.7	54	106
321-60-8	2-Fluorobiphenyl	2263	81.2	12.4	44	119
367-12-4	2-Fluorophenol	2022	68.8	16.6	19	119
91-57-6	2-Methylnaphthalene	6330	80.7	13.6	40	121
95-48-7	2-Methylphenol (o-Cresol)	5800	73	14.5	30	117
88-74-4	2-Nitroaniline	4855	90.8	12.1	55	127
119-75-5	2-Nitrodiphenylamine	272	97.3	11.3	64	131
88-75-5	2-Nitrophenol	5097	84.6	12.7	47	123
109-06-8	2-Picoline [2-Methylpyridine]	195	71.6	12.6	34	109
91-94-1	3,3'-Dichlorobenzidine	4815	77.9	16.9	27	129
56-49-5	3-Methylcholanthrene	237	94	12.8	56	133
99-09-2	3-Nitroaniline	4808	84.4	14.5	41	128
65794-96-9	3/4-Methylphenol [m/p-Cresol]	3472	69.7	13.6	29	110
534-52-1	4,6-Dinitro-2-methylphenol	5097	90.1	15.5	44	137
101-55-3	4-Bromophenyl phenyl ether	5074	89.1	11.5	55	124
59-50-7	4-Chloro-3-methylphenol	5338	85.5	11.3	52	119
106-47-8	4-Chloroaniline [p-Chloroanlinie]	4687	75.3	14	33	117
7005-72-3	4-Chlorophenyl phenyl ether	5071	86.7	11.3	53	121
106-44-5	4-Methylphenol [p-Cresol]	2798	72.5	15.8	25	120
99-55-8	5-Nitro-o-toluidine [2-amino-4-nitrotoluene]	260	82.1	14.6	38	126
57-97-6	7,12-Dimethylbenz(a)-anthracene	373	97.1	11.9	61	133
83-32-9	Acenaphthene	6952	84.5	12.3	47	122
208-96-8	Acenaphthylene	6662	85.3	14.7	41	130
98-86-2	Acetophenone	2877	82.1	12	46	118
120-12-7	Anthracene	6792	89.6	11	57	123
140-57-8	Aramite	100	82.8	16.3	34	132

Table C-26. Method 8270 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
1912-24-9	Atrazine	2328	92.8	16.4	44	142
103-33-3	Azobenzene	578	88.5	9.3	61	116
56-55-3	Benz(a)anthracene	6867	91.6	11.1	58	125
50-32-8	Benzo(a)pyrene	7045	90.8	12.4	54	128
205-99-2	Benzo(b)fluoranthene	6767	92	12.9	53	131
191-24-2	Benzo(g,h,i)perylene	6624	92	13.9	50	134
207-08-9	Benzo(k)fluoranthene	6803	93.2	12.1	57	129
100-51-6	Benzyl alcohol	3349	71.2	13.5	31	112
111-91-1	bis(2-Chloroethoxy)methane	5094	83.9	11.9	48	120
111-44-4	Bis(2-chloroethyl) ether	5139	80.8	12.6	43	118
39638-32-9	bis(2-Chloroisopropyl) ether	1140	83.4	15.4	37	130
117-81-7	Bis(2-ethylhexyl) phthalate	5288	95.2	13.3	55	135
85-68-7	Butyl benzyl phthalate	5173	93.3	13.5	53	134
86-74-8	Carbazole	4187	91.1	10.4	60	122
510-15-6	Chlorobenzilate	226	104.3	15.4	58	150
218-01-9	Chrysene	6779	91.3	10.7	59	123
124-18-5	Decane	126	66.9	12.8	29	105
84-74-2	Di-n-butyl phthalate	5329	93	11.4	59	127
117-84-0	Di-n-octyl phthalate	5222	95.5	15	51	140
2303-16-4	Diallate [cis or trans]	249	95.3	9.6	67	124
226-36-8	Dibenz(a,h)acridine	136	104.4	9.7	75	134
53-70-3	Dibenzo(a,h)anthracene	6840	92.7	13.8	51	134
132-64-9	Dibenzofuran	4963	85.3	10.8	53	118
84-66-2	Diethyl phthalate	5207	90.1	11.5	56	125
131-11-3	Dimethyl phthalate	4977	86	13.7	45	127
60-11-7	Dimethylaminoazobenzene	238	97.1	11.6	62	132
88-85-7	Dinoseb	144	93.4	10.8	61	126
101-84-8	Diphenyl ether	142	91.7	7.8	68	115
122-39-4	Diphenylamine	754	83	9.2	55	111
298-04-4	Disulfoton	122	92.5	12.5	55	130
62-50-0	Ethyl methanesulfonate	215	90.1	9.4	62	118
206-44-0	Fluoranthene	6826	92.6	11.9	57	128

Table C-26. Method 8270 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
86-73-7	Fluorene	6786	88.1	12	52	124
118-74-1	Hexachlorobenzene	6263	88.7	12.1	53	125
87-68-3	Hexachlorobutadiene	5878	73.1	16.9	22	124
67-72-1	Hexachloroethane	5904	68	15.7	21	115
95-13-6	Indene	253	93.8	13.7	53	135
193-39-5	Indeno(1,2,3-cd)pyrene	6880	92.6	13.6	52	134
465-73-6	isodrin	212	97.6	10	68	128
78-59-1	Isophorone	5190	83.3	13.7	42	124
120-58-1	Isosafrole	230	91.1	11.8	56	126
66-27-3	Methyl methanesulfonate	237	70.1	12.3	33	107
298-00-0	Methyl parathion	121	101.6	19	45	159
100-75-4	n-Nitorosopiperidine	299	88.6	10.8	56	121
924-16-3	n-Nitrosodi-n-butylamine	322	90.4	10.3	60	121
621-64-7	n-Nitrosodi-n-propylamine	5145	84	11.7	49	119
55-18-5	n-nitrosodiethylamine	488	81.8	12.9	43	121
86-30-6	n-Nitrosodiphenylamine	3743	86.8	11.9	51	123
10595-95-6	n-Nitrosomethylethylamine	311	78.7	12.7	41	117
59-89-2	n-Nitrosomorpholine	214	86.2	10.3	55	117
930-55-2	n-Nitrosopyrrolidine	716	80.8	10.8	48	113
91-20-3	Naphthalene	6953	80	13.5	40	121
98-95-3	Nitrobenzene	5955	83	12.8	45	121
4165-60-0	Nitrobenzene-d5	2223	82.1	12.6	44	120
126-68-1	O,O,O-Triethyl phosphorothioate	212	92.6	8.8	66	119
95-53-4	o-Toluidine	296	69.9	13.2	30	110
593-45-3	Octadecane	151	89	13.1	50	128
56-38-2	Parathion	152	102.6	12.3	66	140
608-93-5	Pentachlorobenzene	401	91.1	10.7	59	123
76-01-7	Pentachloroethane	139	60.9	10.4	30	92
87-86-5	Pentachlorophenol	6083	86.4	17.1	35	138
82-68-8	Pentchloronitrobenzene	618	94.5	13.4	54	135
62-44-2	Phenacetin	241	97.9	8.9	71	124

Table C-26. Method 8270 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
85-01-8	Phenanthrene	6822	89.6	10.2	59	120
298-02-2	Phorate	126	88.6	16.8	38	139
23950-58-5	Pronamide	249	97	10.5	65	129
129-00-0	Pyrene	7013	91.1	11.5	57	126
91-22-5	Quinoline	249	100.1	10.5	69	132
94-59-7	Safrole	233	90	9.7	61	119
1718-51-0	Terphenyl-d14	1893	91.7	13.9	50	134
3689-24-5	Tetraethyl dithiopyrophosphate [Sulfotep]	200	96.7	11.9	61	133
297-97-2	Thionazine	196	102	10.1	72	132

Table C-27. Method 8270 SIM Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
90-12-0	1-Methylnaphthalene	2267	76.6	11.3	43	111
95-95-4	2,4,5-Trichlorophenol	169	79.9	14.9	35	125
91-58-7	2-Chloronaphthalene	615	76.7	10.5	45	108
321-60-8	2-Fluorobiphenyl	1961	80.6	11.6	46	115
91-57-6	2-Methylnaphthalene	2535	76.8	12.5	39	114
83-32-9	Acenaphthene	2813	77.7	11.2	44	111
208-96-8	Acenaphthylene	2761	77.1	12.8	39	116
120-12-7	Anthracene	2812	82.1	10.7	50	114
56-55-3	Benz(a)anthracene	2827	88	11.4	54	122
50-32-8	Benzo(a)pyrene	2789	87.3	12.5	50	125
205-99-2	Benzo(b)fluoranthene	2790	90.3	12.6	53	128
191-24-2	Benzo(g,h,i)perylene	2739	87.8	13	49	127
207-08-9	Benzo(k)fluoranthene	2761	89.3	11.2	56	123
111-44-4	Bis(2-chloroethyl) ether	192	65.4	15.8	18	113
117-81-7	Bis(2-ethylhexyl) phthalate	181	108.9	13.9	67	150
85-68-7	Butyl benzyl phthalate	144	103.5	10.6	72	135
86-74-8	Carbazole	183	79.3	14.6	36	123

Table C-27. Method 8270 SIM Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
218-01-9	Chrysene	2812	87.5	10.2	57	118
84-74-2	Di-n-butyl phthalate	150	106.5	12.9	68	145
117-84-0	Di-n-octyl phthalate	144	105.5	16.8	55	156
53-70-3	Dibenzo(a,h)anthracene	2778	89.2	13.2	50	129
132-64-9	Dibenzofuran	282	71.9	12.2	35	108
84-66-2	Diethyl phthalate	147	99.3	10.9	67	132
131-11-3	Dimethyl phthalate	149	99.3	9.3	71	127
206-44-0	Fluoranthene	2782	87.3	10.7	55	119
86-73-7	Fluorene	2795	80.6	11.2	47	114
118-74-1	Hexachlorobenzene	201	81.9	14.2	39	125
193-39-5	Indeno(1,2,3-cd)pyrene	2812	89.6	13.5	49	130
62-75-9	n-Nitrosodimethylamine	117	90.7	10.9	58	124
91-20-3	Naphthalene	2823	74.7	12.2	38	111
87-86-5	Pentachlorophenol	259	82.4	15.5	36	129
85-01-8	Phenanthrene	2792	80.8	10.6	49	113
129-00-0	Pyrene	2792	85.8	10.2	55	117

Table C-28. Method 8270 SIM Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
92-52-4	1,1-Biphenyl	106	77.3	7.3	56	99
90-12-0	1-Methylnaphthalene	2566	77.9	12.5	41	115
95-95-4	2,4,5-Trichlorophenol	488	84.1	13.4	44	124
118-79-6	2,4,6-Tribromophenol	164	83.7	12.7	46	122
606-20-2	2,6-Dinitrotoluene	118	67.2	15.8	20	115
91-58-7	2-Chloronaphthalene	717	72.4	12.7	34	111
321-60-8	2-Fluorobiphenyl	747	79.2	8.8	53	106
91-57-6	2-Methylnaphthalene	2984	76.5	12.6	39	114
83-32-9	Acenaphthene	3241	80.9	11.1	48	114
208-96-8	Acenaphthylene	3234	77.8	14.4	35	121
120-12-7	Anthracene	3224	85.8	11	53	119

Table C-28. Method 8270 SIM Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
56-55-3	Benz(a)anthracene	3277	89.3	10.1	59	120
50-32-8	Benzo(a)pyrene	3284	86.4	11.2	53	120
205-99-2	Benzo(b)fluoranthene	3248	89.7	12.3	53	126
191-24-2	Benzo(g,h,i)perylene	3178	86	14.1	44	128
207-08-9	Benzo(k)fluoranthene	3167	89.3	11.9	54	125
111-44-4	Bis(2-chloroethyl) ether	775	77.8	12.6	40	116
117-81-7	Bis(2-ethylhexyl) phthalate	275	114.1	19.6	55	173
85-68-7	Butyl benzyl phthalate	159	90.7	17.3	39	143
86-74-8	Carbazole	631	84	13.1	45	123
218-01-9	Chrysene	3215	88.3	10.4	57	120
84-74-2	Di-n-butyl phthalate	153	102.5	14.2	60	145
117-84-0	Di-n-octyl phthalate	157	103.3	19	46	160
53-70-3	Dibenzo(a,h)anthracene	3233	87.2	14.5	44	131
132-64-9	Dibenzofuran	864	77.5	14.1	35	120
84-66-2	Diethyl phthalate	142	94.5	13.5	54	135
206-44-0	Fluoranthene	3242	89.1	10.4	58	120
86-73-7	Fluorene	3232	84.1	11.3	50	118
118-74-1	Hexachlorobenzene	947	84.8	13	46	124
87-68-3	Hexachlorobutadiene	187	84.5	14.7	40	129
193-39-5	Indeno(1,2,3-cd)pyrene	3244	88.7	13.7	48	130
62-75-9	N-Nitrosodimethylamine	162	62.5	10	33	92
91-20-3	Naphthalene	3277	78.8	11.9	43	114
4165-60-0	Nitrobenzene-d5	444	83.1	9.2	55	111
87-86-5	Pentachlorophenol	808	88.4	17.6	36	141
85-01-8	Phenanthrene	3240	83.6	10.3	53	115
129-00-0	Pyrene	3252	87.1	11.3	53	121
1718-51-0	Terphenyl-d14	642	95.1	12.4	58	132

Table C-29. Method 8290 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
3268-87-9	1,2,3,4,5,6,7,8-Octachlorodibenzo-p-dioxin	824	104.2	10.3	73	135
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	816	104.6	13	66	144
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	813	100.7	8.1	76	125
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	835	103.8	10.2	73	135
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	823	101.1	9.8	72	131
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	830	101.7	9.9	72	131
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	835	103.1	8.9	77	130
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	844	103.7	10	74	134
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	837	103.6	10.3	73	134
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	845	104.8	11.2	71	138
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	895	104.6	10.1	74	135
40321-76-4	1,2,3,7,8-Pentachlorod benzo-p-dioxin	840	99.2	8.6	74	125
57117-41-6	1,2,3,7,8-Pentachlorod benzofuran	803	103.7	8.9	77	131
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran	942	103.4	9.7	74	133
57117-31-4	2,3,4,7,8-Pentachlorod benzofuran	912	101.4	8.9	75	128
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	871	99	9.7	70	128
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	939	105.2	10.1	75	135

Table C-30. Method 8290 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
3268-87-9	1,2,3,4,5,6,7,8-Octachlorodibenzo-p-dioxin	539	107.7	9.1	81	135
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	553	107.9	14.1	66	150
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	537	100.7	7.2	79	122
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	574	105.2	8.1	81	130
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	575	102.7	8.4	77	128
39227-28-6	1,2,3,4,7,8-Hexachlorod benzo-p-dioxin	568	102.9	7.7	80	126
70648-26-9	1,2,3,4,7,8-Hexachlorod benzofuran	579	105	8.4	80	130
57653-85-7	1,2,3,6,7,8-Hexachlorod benzo-p-dioxin	585	105.7	9.4	78	134
57117-44-9	1,2,3,6,7,8-Hexachlorod benzofuran	578	105.1	8.7	79	131
19408-74-3	1,2,3,7,8,9-Hexachlorod benzo-p-dioxin	585	106.6	10.1	76	137
72918-21-9	1,2,3,7,8,9-Hexachlorod benzofuran	577	106.7	7.9	83	130
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	579	98.6	7.5	76	121
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	542	105.8	8	82	130
60851-34-5	2,3,4,6,7,8-Hexachlorod benzofuran	597	105.5	8.1	81	130
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	613	103.1	8.6	77	129
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	635	97.9	9	71	125
51207-31-9	2,3,7,8-Tetrachlorod benzofuran	641	104.9	11.1	72	138

Table C-31. Method 8310 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
90-12-0	1-Methylnaphthalene	740	88.3	16.1	40	137
91-57-6	2-Methylnaphthalene	742	87.3	15.7	40	135
83-32-9	Acenaphthene	826	87	13.2	47	127
208-96-8	Acenaphthylene	815	86.5	10.3	56	117
120-12-7	Anthracene	787	88.9	7.9	65	113
56-55-3	Benz(a)anthracene	838	97.3	9.5	69	126
50-32-8	Benzo(a)pyrene	838	91.3	9.6	63	120
205-99-2	Benzo(b)fluoranthene	838	95.8	8.2	71	120
191-24-2	Benzo(g,h,i)perylene	831	98.6	10	69	129
207-08-9	Benzo(k)fluoranthene	834	95	8.3	70	120
218-01-9	Chrysene	801	95.7	6.5	76	115
53-70-3	Dibenzo(a,h)anthracene	834	94.2	7.9	70	118
206-44-0	Fluoranthene	825	94.6	8.2	70	119
86-73-7	Fluorene	809	89.7	9.6	61	119
193-39-5	Indeno(1,2,3-cd)pyrene	675	98.9	11.6	64	134
91-20-3	Naphthalene	848	85.4	16.6	36	135
85-01-8	Phenanthrene	832	91.3	8.8	65	118
129-00-0	Pyrene	838	93.7	8.3	69	119

Table C-32. Method 8310 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
90-12-0	1-Methylnaphthalene	432	73.3	11	40	106
91-57-6	2-Methylnaphthalene	448	73.4	10.7	41	106
83-32-9	Acenaphthene	493	78.5	11.2	45	112
208-96-8	Acenaphthylene	478	80.5	9.1	53	108
120-12-7	Anthracene	453	85.8	9.2	58	113
56-55-3	Benz(a)anthracene	493	89	11.6	54	124
50-32-8	Benzo(a)pyrene	445	89.1	10.3	58	120
205-99-2	Benzo(b)fluoranthene	467	88.7	11.6	54	124

Table C-32. Method 8310 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
191-24-2	Benzo(g,h,i)perylene	428	88.6	11.3	55	122
207-08-9	Benzo(k)fluoranthene	460	88.4	11.8	53	124
218-01-9	Chrysene	469	90.3	9.6	61	119
53-70-3	Dibenzo(a,h)anthracene	452	87.2	10.5	56	119
206-44-0	Fluoranthene	485	86.9	10.6	55	119
86-73-7	Fluorene	483	82.2	9.7	53	111
193-39-5	Indeno(1,2,3-cd)pyrene	458	89.4	12.2	53	126
91-20-3	Naphthalene	440	73.3	10.5	42	105
85-01-8	Phenanthrene	489	85.2	9.5	57	114
129-00-0	Pyrene	472	86.3	9.3	58	114

Table C-33. Method 8321 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
99-35-4	1,3,5-Trinitrobenzene	228	92.4	7.6	69	115
99-65-0	1,3-Dinitrobenzene	234	102.4	6.5	83	122
118-96-7	2,4,6-Trinitrotoluene	222	99	11.4	65	133
121-14-2	2,4-Dinitrotoluene	229	100.7	6.1	82	119
606-20-2	2,6-Dinitrotoluene	225	99.7	4.6	86	113
35572-78-2	2-Amino-4,6-dinitrotoluene	230	102.2	9.2	75	130
88-72-2	2-Nitrotoluene	232	98.1	8.8	72	125
99-08-1	3-Nitrotoluene	235	96.8	9.5	68	125
19406-51-0	4-Amino-2,6-dinitrotoluene	230	101.2	8.1	77	125
99-99-0	4-Nitrotoluene	231	99.2	9.1	72	127
121-82-4	Hexahydro-1,3,5-trinitro- 1,3,5-triazine (RDX)	231	100.2	7.6	77	123
98-95-3	Nitrobenzene	221	97.1	7.5	75	120
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	225	89.3	8.1	65	114
78-11-5	PETN	229	102.3	13.6	62	143
479-45-8	Tetryl	214	78	13.9	36	120

Table C-34. Method 8321 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
99-35-4	1,3,5-Trinitrobenzene	452	88.6	7.4	66	111
99-65-0	1,3-Dinitrobenzene	460	98	6.5	78	118
118-96-7	2,4,6-Trinitrotoluene	413	98.4	10.1	68	129
121-14-2	2,4-Dinitrotoluene	458	96.4	6.9	76	117
606-20-2	2,6-Dinitrotoluene	447	93.7	4.7	80	108
35572-78-2	2-Amino-4,6-dinitrotoluene	456	97.9	9.6	69	127
88-72-2	2-Nitrotoluene	359	82	10.1	52	112
99-08-1	3-Nitrotoluene	356	83	9.7	54	112
19406-51-0	4-Amino-2,6-dinitrotoluene	459	96.7	9.7	68	126
99-99-0	4-Nitrotoluene	361	85.5	10.6	54	117
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	458	99.6	8.9	73	126
98-95-3	Nitrobenzene	353	84.6	7.7	61	108
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	452	87	8.3	62	112
78-11-5	PETN	354	95	11	62	128
479-45-8	Tetryl	330	86.2	17.1	35	138

Table C-35. Method 8330 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	339	105.7	5.7	89	123
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	607	101.9	7	81	123
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	602	104.2	6.7	84	124
118-96-7	2,4,6-Trinitrotoluene	618	100.2	8.4	75	125
121-14-2	2,4-Dinitrotoluene	600	102.3	6.9	82	123
606-20-2	2,6-Dinitrotoluene	556	102.4	5.4	86	119
35572-78-2	2-Amino-4,6-dinitrotoluene	562	103.8	5.7	87	121

Table C-35. Method 8330 Solid Matrix

88-72-2	2-Nitrotoluene	591	102	6	84	120
99-08-1	3-Nitrotoluene	614	103.3	8	79	127
19406-51-0	4-Amino-2,6-dinitrotoluene	594	104.2	6.7	84	124
99-99-0	4-Nitrotoluene	595	102.2	6.5	83	122
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	595	103.1	6.9	82	124
98-95-3	Nitrobenzene	598	103.9	7.9	80	128
55-63-0	Nitroglycerin	352	97.2	8.2	73	122
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	581	99.1	7.5	77	122
78-11-5	PETN	326	100.9	7.5	78	123
479-45-8	Tetryl	584	101.8	11.9	66	138

Table C-36. Method 8330 - 8330B Series Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	978	101.1	6	83	119
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	1578	99	8.5	73	125
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	1572	98.7	7	78	120
118-96-7	2,4,6-Trinitrotoluene	1728	97	8.6	71	123
6629-29-4	2,4-Diamino-6-nitrotoluene	578	95	9.1	68	122
121-14-2	2,4-Dinitrotoluene	1563	98.9	7.1	78	120
59229-75-3	2,6-Diamino-4-nitrotoluene	577	96.6	8.3	72	122
606-20-2	2,6-Dinitrotoluene	1693	102	8.3	77	127
35572-78-2	2-Amino-4,6-dinitrotoluene	1568	99.4	6.8	79	120
88-72-2	2-Nitrotoluene	1630	98.4	9.6	70	127
618-87-1	3,5-Dinitroaniline	150	94.3	7.6	71	117
99-08-1	3-Nitrotoluene	1643	98.8	8.8	73	125
19406-51-0	4-Amino-2,6-dinitrotoluene	1586	100.3	8	76	125
99-99-0	4-Nitrotoluene	1654	99.1	9.3	71	127
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	1833	99.1	10.4	68	130
80251-29-2	Hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine (DNX)	109	92.8	8.8	66	119

Table C-36. Method 8330 - 8330B Series Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
5755-27-1	Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine (MNX)	249	94.3	12.5	57	132
98-95-3	Nitrobenzene	1743	99.3	11.4	65	134
55-63-0	Nitroglycerin	1076	100.4	8.8	74	127
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	1755	100	11.8	65	135
78-11-5	PETN	1079	100.2	9	73	127
479-45-8	Tetryl	1597	95.8	10.7	64	128

Table C-37. Method 8330B Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	283	98.9	6.8	78	119
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	450	98	6.1	80	116
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	461	96.3	7.7	73	119
118-96-7	2,4,6-Trinitrotoluene	443	95.8	8.2	71	120
121-14-2	2,4-Dinitrotoluene	457	98	7.5	75	121
606-20-2	2,6-Dinitrotoluene	430	98	6.3	79	117
35572-78-2	2-Amino-4,6-dinitrotoluene	455	96.5	8.7	71	123
88-72-2	2-Nitrotoluene	447	96.8	9.1	70	124
618-87-1	3,5-Dinitroaniline	115	101.6	5.3	86	118
99-08-1	3-Nitrotoluene	448	97.7	10.3	67	129
19406-51-0	4-Amino-2,6-dinitrotoluene	434	95.4	10.6	64	127
99-99-0	4-Nitrotoluene	451	97.3	8.9	71	124
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	457	97.9	10.3	67	129
98-95-3	Nitrobenzene	440	97.9	10.4	67	129
55-63-0	Nitroglycerin	386	98.1	8.5	73	124
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	422	99.1	8.2	74	124
78-11-5	PETN	376	100.1	9.4	72	128
479-45-8	Tetryl	377	101.3	11.1	68	135

Table C-38. Method 9010 - 9020 Series Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
57-12-5	Cyanide, Total	842	98.2	7.4	76	120

Table C-39. Method 9010 - 9020 Series Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
57-12-5	Cyanide, Total	1660	99	5.5	83	116

Table C-40. Method 9056 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
24959-67-9	Bromide	222	101	5.1	86	116
16887-00-6	Chloride	612	100.9	4.7	87	115
16984-48-8	Fluoride	300	100.3	9.1	73	128
14797-55-8	Nitrate	680	99.2	4	87	111
14797-65-0	Nitrite	419	100.3	4.9	86	115
14265-44-2	Phosphate	142	102.4	3.8	91	114
14808-79-8	Sulfate	305	100.9	4.7	87	115

Table C-41. Method 9056 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
24959-67-9	Bromide	2199	100.3	3.2	91	110
16887-00-6	Chloride	4948	98.5	4	87	111
16984-48-8	Fluoride	3251	99.7	4	88	112
14797-55-8	Nitrate	3192	99.7	3.9	88	111

Table C-41. Method 9056 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
14797-65-0	Nitrite	2583	98.9	3.9	87	111
14265-44-2	Phosphate	843	97.8	6.1	80	116
14808-79-8	Sulfate	4155	99.2	4.1	87	112

Table C-42. Method RSK-175 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
74-86-2	Acetylene	719	99.6	9.8	70	129
106-97-8	Butane	262	97.3	7.3	75	119
124-38-9	Carbon dioxide	441	100.8	6.9	80	122
74-84-0	Ethane	2240	102.6	9.6	74	131
74-85-1	Ethylene	2284	102.5	10.2	72	133
75-28-5	Isobutane	267	97.6	6.6	78	117
74-82-8	Methane	2459	99.2	8.7	73	125
74-98-6	Propane	900	98.1	8.2	74	123

Table C-43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
630-20-6	1,1,1,2-Tetrachloroethane	1344	97.9	10.5	67	129
71-55-6	1,1,1-Trichloroethane	5436	96.7	9.5	68	125
79-34-5	1,1,2,2-Tetrachloroethane	5273	95.9	10.4	65	127
79-00-5	1,1,2-Trichloroethane	5332	95.9	7.7	73	119
76-13-1	1,1,2-Trifluoro-1,2,2-trichloroethane [Freon-113]	5351	96.1	10	66	126
75-34-3	1,1-Dichloroethane	5422	97	9.7	68	126
75-35-4	1,1-Dichloroethene	3503	97.3	11.9	61	133
96-18-4	1,2,3-Trichloropropane	465	99.6	8	76	124
120-82-1	1,2,4-Trichlorobenzene	4545	98.5	14.5	55	142
95-63-6	1,2,4-Trimethylbenzene	4699	99.2	11.1	66	132

Table C-43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
106-93-4	1,2-D bromoethane	4655	98.2	7.9	74	122
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	4572	92.4	9.7	63	121
95-50-1	1,2-Dichlorobenzene	4739	95.7	11	63	129
107-06-2	1,2-Dichloroethane	5467	96.8	10.5	65	128
78-87-5	1,2-Dichloropropane	4729	95.7	8.9	69	123
108-67-8	1,3,5-Trimethylbenzene	4679	98.3	10.4	67	130
106-99-0	1,3-Butadiene	3167	99.8	11.4	66	134
541-73-1	1,3-Dichlorobenzene	4737	97.1	10.9	65	130
142-28-9	1,3-Dichloropropane	165	105.2	14.4	62	148
542-75-6	1,3-Dichloropropene	560	100.7	8.1	77	125
106-46-7	1,4-Dichlorobenzene	4719	95.8	11.8	60	131
123-91-1	1,4-Dioxane	2656	96.5	8.6	71	122
540-84-1	2,2,4-Trimethylpentane [Isooctane]	3008	94.3	8.8	68	121
78-93-3	2-Butanone [MEK]	4635	98.4	10.4	67	130
95-49-8	2-Chlorotoluene	1092	101.9	9.2	74	130
591-78-6	2-Hexanone	4600	95.4	11	62	128
67-63-0	2-Propanol [Isopropyl alcohol]	3069	88.4	12.3	52	125
622-96-8	4-Ethyltoluene	4673	97.9	10.3	67	129
108-10-1	4-Methyl-2-pentanone [MIBK]	4646	98.5	10.5	67	130
67-64-1	Acetone	4600	92.7	11.6	58	128
75-05-8	Acetonitrile	1999	97.3	11.6	63	132
107-02-8	Acrolein [Propenal]	2469	93.8	10.6	62	126
107-13-1	Acrylonitrile	2105	103.7	10.9	71	137
107-05-1	Allyl chloride	2980	101.1	10.1	71	131
98-83-9	alpha-Methylstyrene	1976	97.3	10.2	67	128
71-43-2	Benzene	5436	93.8	8.4	69	119
100-44-7	Benzyl chloride	4419	98.7	16.2	50	147
75-27-4	Bromodichloromethane	4682	99.9	9.3	72	128
75-25-2	Bromoform	4638	102.3	12.1	66	139
74-83-9	Bromomethane	2657	98.6	11.8	63	134
106-97-8	Butane	587	96.2	10.9	64	129

Table C-43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
75-15-0	Carbon disulfide	4756	95.6	12.7	57	134
56-23-5	Carbon tetrachloride	4202	99.6	10.7	68	132
108-90-7	Chlorobenzene	4652	94.5	8	70	119
124-48-1	Chlorodibromomethane	4628	99.9	10	70	130
75-45-6	Chlorodifluoromethane	559	102.1	14.3	59	145
75-00-3	Chloroethane	5370	94.7	10.6	63	127
67-66-3	Chloroform	5481	95.3	9.3	68	123
74-87-3	Chloromethane	4540	95.2	12.2	59	132
156-59-2	cis-1,2-Dichloroethene	5320	95.6	8.4	70	121
10061-01-5	cis-1,3-Dichloropropene	4691	98.8	9.7	70	128
110-82-7	Cyclohexane	3178	93.5	7.7	70	117
124-18-5	Decane	1982	93.8	7.9	70	118
75-71-8	Dichlorodifluoromethane [Freon-12]	5307	93.6	11.5	59	128
108-20-3	Diisopropyl ether	2309	93.5	8	70	117
64-17-5	Ethanol	2981	91.8	11.1	59	125
141-78-6	Ethyl acetate	2835	96.4	10.5	65	128
100-41-4	Ethylbenzene	5420	96.8	9	70	124
142-82-5	Heptane	3163	95.7	8.9	69	123
87-68-3	Hexachlorobutadiene	4551	96.7	13.7	56	138
110-54-3	Hexane	3150	91.6	9.5	63	120
98-82-8	Isopropylbenzene	3022	95.6	9.3	68	124
179601-23-1	m/p-Xylene [3/4-Xylene]	5019	97.3	12.3	61	134
80-62-6	Methyl methacrylate	3037	98.9	9.7	70	128
1634-04-4	Methyl tert-butyl ether [MTBE]	4681	95.5	10	66	126
75-09-2	Methylene chloride	5314	88.8	8.9	62	115
71-36-3	n-Butyl alcohol	1981	97.5	11.7	62	133
104-51-8	n-Butylbenzene	2656	97.7	10.6	66	130
112-40-3	n-DoDecane	1932	104.4	14.1	62	147
103-65-1	n-Propylbenzene	2570	95.7	9	69	123
91-20-3	Naphthalene	2439	97.5	13.4	57	138
111-84-2	Nonane	2617	95.4	10.8	63	128

Table C-43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
95-47-6	o-Xylene	5334	96.3	9.7	67	125
111-65-9	Octane	2514	95	8.7	69	121
99-87-6	p-Isopropyltoluene [p-Cymene]	2694	98.1	10.5	67	130
109-66-0	Pentane	712	96.7	11.3	63	131
115-07-1	Propene	3193	96.6	13.3	57	136
135-98-8	sec-Buty benzene	2665	96.4	9.6	68	125
100-42-5	Styrene	4735	100.1	9	73	127
75-65-0	tert-Butyl alcohol	2997	86.8	20.9	24	150
98-06-6	tert-Butylbenzene	2710	94.3	9.8	65	124
127-18-4	Tetrachloroethene	5432	95.2	9.7	66	124
109-99-9	Tetrahydrofuran	3192	93.7	9.8	64	123
108-88-3	Toluene	5406	92.7	8.8	66	119
156-60-5	trans-1,2-Dichloroethene	5411	95.5	9.5	67	124
10061-02-6	trans-1,3-Dichloropropene	4621	104	9.6	75	133
79-01-6	Trichloroethene	5478	96.7	8.7	71	123
75-69-4	Trichlorofluoromethane [Freon-11]	5376	93.7	10.6	62	126
1120-21-4	Undecane	1976	96.1	9	69	123
108-05-4	Vinyl acetate	4599	97.4	13.7	56	139
593-60-2	Vinyl bromide	1054	98.4	9.2	71	126
75-01-4	Vinyl chloride	5445	95.1	10.4	64	127

Table C-44. Method PFAS by LCMSMS Compliant with QSM Table B-15 Aqueous Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
2991-50-6	2-(N-Ethylperfluorooctanesulfonamido) acetic acid	1210	97.9	12.2	61	135
2355-31-9	2-(N-Methylperfluorooctanesulfonamido) acetic acid	1219	100.9	11.7	65	136
757124-72-4	Fluorotelomer sulphonic acid 4:2	789	103.2	13.2	63	143

27619-97-2	Fluorotelomer sulphonic acid 6:2	1673	102.4	12.5	64	140
39108-34-4	Fluorotelomer sulphonic acid 8:2	1657	102.3	11.6	67	138
31506-32-8	N-methylperfluorooctanesulfonamide	404	104.1	12.0	68	141
375-73-5	Perfluorobutanesulfonic acid	1832	100.8	9.4	72	130
375-22-4	Perfluorobutanoic acid	1270	100.6	9.2	73	129
335-77-3	Perfluorodecanesulfonic acid	1361	97.7	14.8	53	142
335-76-2	Perfluorodecanoic acid	1722	100.4	9.5	71	129
307-55-1	Perfluorododecanoic acid	1714	102.8	10.2	72	134
375-92-8	Perfluoroheptanesulfonic acid	1552	101.9	10.7	69	134
375-85-9	Perfluoroheptanoic acid	1837	101.4	9.5	72	130
355-46-4	Perfluorohexanesulfonic acid	1849	99.7	10.3	68	131
307-24-4	Perfluorohexanoic acid	1797	100.4	9.4	72	129
68259-12-1	Perfluorononanesulfonic acid	780	97.7	9.5	69	127
375-95-1	Perfluorononanoic acid	1846	99.9	10.0	69	130
754-91-6	Perfluorooctanesulfonamide	1453	101.9	11.4	67	137
1763-23-1	Perfluorooctanesulfonic acid	1744	102.7	12.4	65	140
335-67-1	Perfluorooctanoic acid	1962	102.2	10.1	71	133
2706-91-4	Perfluoropentanesulfonic acid	812	99.0	9.2	71	127
2706-90-3	Perfluoropentanoic acid	1695	100.7	9.3	72	129
376-06-7	Perfluorotetradecanoic acid	1714	101.8	10.0	71	132
72629-94-8	Perfluorotridecanoic acid	1696	104.8	13.0	65	144
2058-94-8	Perfluoroundecanoic acid	1746	100.8	10.6	69	133

Table C-45. Method PFAS by LCMSMS Compliant with QSM Table B-15 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
2991-50-6	2-(N-Ethylperfluorooctanesulfonamido) acetic acid	249	99.7	12.9	61	139
2355-31-9	2-(N-Methylperfluorooctanesulfonamido) acetic acid	254	103.9	13.3	63	144
757124-72-4	Fluorotelomer sulphonic acid 4:2	266	103.1	13.7	62	145
27619-97-2	Fluorotelomer sulphonic acid 6:2	575	101.9	12.4	64	140

Table C-45. Method PFAS by LCMSMS Compliant with QSM Table B-15 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
39108-34-4	Fluorotelomer sulphonic acid 8:2	544	100.8	11.8	65	137
375-73-5	Perfluorobutanesulfonic acid	624	100.5	9.2	72	128
375-22-4	Perfluorobutanoic acid	333	102.9	10.5	71	135
335-77-3	Perfluorodecanesulfonic acid	336	96.2	12.4	59	134
335-76-2	Perfluorodecanoic acid	569	101.0	10.4	69	133
307-55-1	Perfluorododecanoic acid	565	101.7	10.8	69	135
375-92-8	Perfluoroheptanesulfonic acid	511	101.0	10.3	70	132
375-85-9	Perfluoroheptanoic acid	652	101.2	10.0	71	131
355-46-4	Perfluorohexanesulfonic acid	639	98.5	10.5	67	130
307-24-4	Perfluorohexanoic acid	614	100.8	10.2	70	132
68259-12-1	Perfluorononanesulfonic acid	338	96.8	9.1	69	125
375-95-1	Perfluorononanoic acid	650	100.3	9.3	72	129
754-91-6	Perfluorooctanesulfonamide	377	102.2	11.5	67	137
1763-23-1	Perfluorooctanesulfonic acid	518	101.9	11.3	68	136
335-67-1	Perfluorooctanoic acid	663	101.1	10.4	69	133
2706-91-4	Perfluoropentanesulfonic acid	335	97.9	8.1	73	123
2706-90-3	Perfluoropentanoic acid	588	100.2	10.3	69	132
376-06-7	Perfluorotetradecanoic acid	551	101.3	10.5	69	133
72629-94-8	Perfluorotridecanoic acid	548	102.3	12.1	66	139
2058-94-8	Perfluoroundecanoic acid	587	99.9	12.0	64	136

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

CERTIFICATE OF ENVIRONMENTAL LABORATORY ACCREDITATION

Is hereby granted to

Eurofins TestAmerica Denver

4955 Yarrow Street

Arvada, CO 80002

Scope of the certificate is limited to the
"Fields of Accreditation"
which accompany this Certificate.

Continued accredited status depends on compliance with applicable laws and regulations, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of
Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **2513**

Effective Date: **1/9/2021**

Expiration Date: **1/8/2022**

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Christine Sotelo, Chief
Environmental Laboratory Accreditation Program

CALIFORNIA STATE
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Fields of Accreditation

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Arvada, CO 80002
Phone: 3037360100

Certificate Number: **2513**
Expiration Date: **1/8/2022**

Primary Accreditation Body

Field of Accreditation: 108 - Inorganic Constituents in Non-Potable Water

108.007	001	Residue, Volatile	EPA 160.4 (1971)	OR
108.009	001	Turbidity	EPA 180.1 (1993 Rev. 2.0)	OR
108.013	001	Calcium	EPA 200.7 (1994 Rev. 4.4)	OR
108.013	002	Magnesium	EPA 200.7 (1994 Rev. 4.4)	OR
108.013	003	Phosphorus,Total	EPA 200.7 (1994 Rev. 4.4)	OR
108.013	004	Potassium	EPA 200.7 (1994 Rev. 4.4)	OR
108.013	005	Silica, Dissolved	EPA 200.7 (1994 Rev. 4.4)	OR
108.013	006	Sodium	EPA 200.7 (1994 Rev. 4.4)	OR
108.017	001	Bromide	EPA 300.0 (1993 Rev. 2.1)	OR
108.017	002	Chloride	EPA 300.0 (1993 Rev. 2.1)	OR
108.017	003	Fluoride	EPA 300.0 (1993 Rev. 2.1)	OR
108.017	004	Nitrate (as N)	EPA 300.0 (1993 Rev. 2.1)	OR
108.017	005	Nitrate-Nitrite (as N)	EPA 300.0 (1993 Rev. 2.1)	OR
108.017	006	Nitrite (as N)	EPA 300.0 (1993 Rev. 2.1)	OR
108.017	007	Phosphate,Ortho (as P)	EPA 300.0 (1993 Rev. 2.1)	OR
108.017	008	Sulfate (as SO4)	EPA 300.0 (1993 Rev. 2.1)	OR
108.023	001	Cyanide, Total	EPA 335.4 (1993 Rev. 1.0)	OR
108.025	001	Ammonia (as N)	EPA 350.1 (1993 Rev. 2.0)	OR
108.029	001	Kjeldahl Nitrogen,Total (as N)	EPA 351 2 (1993 Rev. 2.0)	OR
108.033	001	Nitrate-Nitrite (as N)	EPA 353 2 (1993 Rev. 2.0)	OR
108.033	002	Nitrite (as N)	EPA 353 2 (1993 Rev. 2.0)	OR
108.035	001	Phosphate,Ortho (as P)	EPA 365.1 (1993 Rev. 2.0)	OR
108.035	002	Phosphorus,Total	EPA 365.1 (1993 Rev. 2.0)	OR
108.045	001	Chemical Oxygen Demand	EPA 410.4 (1993 Rev. 2.0)	OR
108.047	001	Phenols, Total	EPA 420.1 (1978 Rev. 1.0)	OR
108.049	001	Phenols, Total	EPA 420.4 (1993 Rev. 2.0)	OR
108.053	001	Oil & Grease Total	EPA 1664 A	OR
108.053	002	Oil & Grease Total	EPA 1664 B	OR
108.063	001	Alkalinity	SM 2320 B-2011	OR
108.065	001	Hardness (Calculation)	SM 2340 B-2011	OR
108.071	001	Residue, Total	SM 2540 B-2011	OR
108.073	001	Residue, Filterable TDS	SM 2540 C-2011	OR
108.075	001	Residue, Non-filterable TSS	SM 2540 D-2011	OR

As of 1/25/2021 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Eurofins TestAmerica Denver

Certificate Number: 2513
Expiration Date: 1/8/2022

108.125	001	Cyanide, Total	SM 4500-CN E-2011	OR
108.129	001	Cyanide, Available	SM 4500-CN G-2011	OR
108.137	001	Hydrogen Ion (pH)	SM 4500-H+ B-2011	OR
108.153	001	Nitrite (as N)	SM 4500-NO2 B-2011	OR
108.201	001	Sulfide (as S)	SM 4500-S D-2011	OR
108.203	001	Sulfide (as S)	SM 4500-S F-2011	OR
108.207	001	Biochemical Oxygen Demand	SM 5210 B-2011	OR
108.207	002	Carbonaceous BOD	SM 5210 B-2011	OR
108.215	001	Organic Carbon-Total (TOC)	SM 5310 B-2011	OR

Field of Accreditation: 109 - Metals and Trace Elements in Non-Potable Water

109.623	001	Aluminum	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	002	Antimony	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	003	Arsenic	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	004	Barium	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	005	Beryllium	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	007	Cadmium	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	008	Chromium	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	009	Cobalt	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	010	Copper	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	011	Iron	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	012	Lead	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	013	Manganese	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	014	Molybdenum	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	015	Nickel	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	016	Selenium	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	017	Silver	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	018	Thallium	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	019	Tin	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	021	Vanadium	EPA 200.7 (1994 Rev. 4.4)	OR
109.623	022	Zinc	EPA 200.7 (1994 Rev. 4.4)	OR
109.625	002	Antimony	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	003	Arsenic	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	004	Barium	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	005	Beryllium	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	007	Cadmium	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	008	Chromium	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	009	Cobalt	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	010	Copper	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	013	Lead	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	014	Manganese	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	015	Molybdenum	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	016	Nickel	EPA 200.8 (1994 Rev. 5.4)	OR

Eurofins TestAmerica Denver

Certificate Number: 2513
Expiration Date: 1/8/2022

109.625	017	Selenium	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	018	Silver	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	019	Thallium	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	022	Vanadium	EPA 200.8 (1994 Rev. 5.4)	OR
109.625	023	Zinc	EPA 200.8 (1994 Rev. 5.4)	OR
109.635	001	Mercury	EPA 245.1 (1994 Rev. 3.0)	OR
109.685	002	Chromium VI (Hexavalent Chromium)	SM 3500-Cr B-2011	OR

Field of Accreditation: 110 - Volatile Organic Constituents in Non-Potable Water

110.040	001	Acetone	EPA 624.1	OR
110.040	003	Acrolein	EPA 624.1	OR
110.040	004	Acrylonitrile	EPA 624.1	OR
110.040	005	Benzene	EPA 624.1	OR
110.040	006	Bromodichloromethane	EPA 624.1	OR
110.040	007	Bromoform	EPA 624.1	OR
110.040	008	Bromomethane (Methyl Bromide)	EPA 624.1	OR
110.040	010	Carbon Tetrachloride	EPA 624.1	OR
110.040	011	Chlorobenzene	EPA 624.1	OR
110.040	012	Chloroethane	EPA 624.1	OR
110.040	013	2-Chloroethyl vinyl Ether	EPA 624.1	OR
110.040	014	Chloroform	EPA 624.1	OR
110.040	015	Chloromethane (Methyl Chloride)	EPA 624.1	OR
110.040	016	Dibromochloromethane (Chlorodibromomethane)	EPA 624.1	OR
110.040	017	1,2-Dichlorobenzene	EPA 624.1	OR
110.040	018	1,3-Dichlorobenzene	EPA 624.1	OR
110.040	019	1,4-Dichlorobenzene	EPA 624.1	OR
110.040	020	1,1-Dichloroethane	EPA 624.1	OR
110.040	021	1,2-Dichloroethane (Ethylene Dichloride)	EPA 624.1	OR
110.040	022	1,1-Dichloroethylene (1,1-Dichloroethene)	EPA 624.1	OR
110.040	023	trans-1,2-Dichloroethylene (trans- 1,2 Dichloroethene)	EPA 624.1	OR
110.040	024	1,2-Dichloropropane	EPA 624.1	OR
110.040	025	cis-1,3-Dichloropropylene (cis 1,3 Dichloropropene)	EPA 624.1	OR
110.040	026	trans-1,3-Dichloropropylene (trans-1,3 Dichloropropene)	EPA 624.1	OR
110.040	029	Ethylbenzene	EPA 624.1	OR
110.040	031	Methylene Chloride (Dichloromethane)	EPA 624.1	OR
110.040	032	4-Methyl-2-pentanone (MIBK)	EPA 624.1	OR
110.040	034	1,1,2,2-Tetrachloroethane	EPA 624.1	OR
110.040	035	Tetrachloroethylene (Tetrachloroethene)	EPA 624.1	OR
110.040	037	Toluene	EPA 624.1	OR
110.040	038	1,1,1-Trichloroethane	EPA 624.1	OR
110.040	039	1,1,2-Trichloroethane	EPA 624.1	OR
110.040	040	Trichloroethylene (Trichloroethene)	EPA 624.1	OR
110.040	041	Vinyl Chloride	EPA 624.1	OR

Eurofins TestAmerica Denver

Certificate Number: 2513
Expiration Date: 1/8/2022

110.040	043	o-Xylene	EPA 624.1	OR
110.040	045	Trichlorofluoromethane	EPA 624.1	OR
110.040	046	m+p-Xylene	EPA 624.1	OR
110.040	047	2-Butanone (MEK)	EPA 624.1	OR

Field of Accreditation: 111 - Semi-volatile Organic Constituents in Non-Potable Water

111.055	001	Aldrin	EPA 608.3	OR
111.055	002	alpha-BHC	EPA 608.3	OR
111.055	003	beta-BHC	EPA 608.3	OR
111.055	004	delta-BHC	EPA 608.3	OR
111.055	005	gamma-BHC (Lindane)	EPA 608.3	OR
111.055	006	Chlordane	EPA 608.3	OR
111.055	007	4,4'-DDD	EPA 608.3	OR
111.055	008	4,4'-DDE	EPA 608.3	OR
111.055	009	4,4'-DDT	EPA 608.3	OR
111.055	010	Dieldrin	EPA 608.3	OR
111.055	011	Endosulfan I	EPA 608.3	OR
111.055	012	Endosulfan II	EPA 608.3	OR
111.055	013	Endosulfan Sulfate	EPA 608.3	OR
111.055	014	Endrin	EPA 608.3	OR
111.055	015	Endrin Aldehyde	EPA 608.3	OR
111.055	016	Heptachlor	EPA 608.3	OR
111.055	017	Heptachlor Epoxide	EPA 608.3	OR
111.055	019	PCB-1016 (Aroclor-1016)	EPA 608.3	OR
111.055	020	PCB-1221 (Aroclor-1221)	EPA 608.3	OR
111.055	021	PCB-1232 (Aroclor-1232)	EPA 608.3	OR
111.055	022	PCB-1242 (Aroclor-1242)	EPA 608.3	OR
111.055	023	PCB-1248 (Aroclor-1248)	EPA 608.3	OR
111.055	024	PCB-1254 (Aroclor-1254)	EPA 608.3	OR
111.055	025	PCB-1260 (Aroclor-1260)	EPA 608.3	OR
111.055	060	Toxaphene	EPA 608.3	OR
111.160	001	Acenaphthene	EPA 625.1	OR
111.160	002	Acenaphthylene	EPA 625.1	OR
111.160	003	Anthracene	EPA 625.1	OR
111.160	004	Benzidine	EPA 625.1	OR
111.160	005	Benzo(a)anthracene	EPA 625.1	OR
111.160	006	Benzo(a)pyrene	EPA 625.1	OR
111.160	007	Benzo(b)fluoranthene	EPA 625.1	OR
111.160	008	Benzo(g,h,i)perylene	EPA 625.1	OR
111.160	009	Benzo(k)fluoranthene	EPA 625.1	OR
111.160	010	Bis(2-chloroethoxy) Methane	EPA 625.1	OR
111.160	011	Bis(2-chloroethyl) Ether	EPA 625.1	OR
111.160	012	bis(2-Chloroisopropyl) ether (2,2'-Oxybis[1-chloroprop	EPA 625.1	OR

Eurofins TestAmerica Denver

Certificate Number: 2513
Expiration Date: 1/8/2022

111.160	013	Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl) phthalate	EPA 625.1	OR
111.160	014	4-Bromophenyl Phenyl Ether	EPA 625.1	OR
111.160	015	Butyl Benzyl Phthalate	EPA 625.1	OR
111.160	016	2-Chloronaphthalene	EPA 625.1	OR
111.160	017	4-Chlorophenyl Phenyl Ether	EPA 625.1	OR
111.160	018	Chrysene	EPA 625.1	OR
111.160	019	Dibenz(a,h)anthracene	EPA 625.1	OR
111.160	020	3,3'-Dichlorobenzidine	EPA 625.1	OR
111.160	021	Diethyl Phthalate	EPA 625.1	OR
111.160	022	Dimethyl Phthalate	EPA 625.1	OR
111.160	023	Di-n-butyl Phthalate	EPA 625.1	OR
111.160	024	2,4-Dinitrotoluene	EPA 625.1	OR
111.160	025	2,6-Dinitrotoluene	EPA 625.1	OR
111.160	026	Di-n-octyl Phthalate	EPA 625.1	OR
111.160	027	Fluoranthene	EPA 625.1	OR
111.160	028	Fluorene	EPA 625.1	OR
111.160	029	Hexachlorobenzene	EPA 625.1	OR
111.160	030	Hexachlorobutadiene	EPA 625.1	OR
111.160	031	Hexachloroethane	EPA 625.1	OR
111.160	032	Indeno(1,2,3-c,d)pyrene	EPA 625.1	OR
111.160	033	Isophorone	EPA 625.1	OR
111.160	034	Naphthalene	EPA 625.1	OR
111.160	035	Nitrobenzene	EPA 625.1	OR
111.160	036	N-nitroso-di-n-propylamine	EPA 625.1	OR
111.160	037	Phenanthrene	EPA 625.1	OR
111.160	038	Pyrene	EPA 625.1	OR
111.160	039	1,2,4-Trichlorobenzene	EPA 625.1	OR
111.160	040	4-Chloro-3-methylphenol	EPA 625.1	OR
111.160	041	2-Chlorophenol	EPA 625.1	OR
111.160	042	2,4-Dichlorophenol	EPA 625.1	OR
111.160	043	2,4-Dimethylphenol	EPA 625.1	OR
111.160	044	2,4-Dinitrophenol	EPA 625.1	OR
111.160	045	2-Methyl-4,6-dinitrophenol	EPA 625.1	OR
111.160	046	2-Nitrophenol	EPA 625.1	OR
111.160	047	4-Nitrophenol	EPA 625.1	OR
111.160	048	Pentachlorophenol	EPA 625.1	OR
111.160	049	Phenol	EPA 625.1	OR
111.160	050	2,4,6-Trichlorophenol	EPA 625.1	OR

Field of Accreditation: 114 - Inorganic Chemistry of Hazardous Waste

114.010	001	Antimony	EPA 6010 B	OR
114.010	002	Arsenic	EPA 6010 B	OR
114.010	003	Barium	EPA 6010 B	OR

Eurofins TestAmerica Denver

Certificate Number: 2513
Expiration Date: 1/8/2022

114.010	004	Beryllium	EPA 6010 B		OR
114.010	005	Cadmium	EPA 6010 B		OR
114.010	006	Chromium	EPA 6010 B		OR
114.010	007	Cobalt	EPA 6010 B		OR
114.010	008	Copper	EPA 6010 B		OR
114.010	009	Lead	EPA 6010 B		OR
114.010	010	Molybdenum	EPA 6010 B		OR
114.010	011	Nickel	EPA 6010 B		OR
114.010	012	Selenium	EPA 6010 B		OR
114.010	013	Silver	EPA 6010 B		OR
114.010	014	Thallium	EPA 6010 B		OR
114.010	015	Vanadium	EPA 6010 B		OR
114.010	016	Zinc	EPA 6010 B		OR
114.020	001	Antimony	EPA 6020		OR
114.020	002	Arsenic	EPA 6020		OR
114.020	003	Barium	EPA 6020		OR
114.020	004	Beryllium	EPA 6020		OR
114.020	005	Cadmium	EPA 6020		OR
114.020	006	Chromium	EPA 6020		OR
114.020	007	Cobalt	EPA 6020		OR
114.020	008	Copper	EPA 6020		OR
114.020	009	Lead	EPA 6020		OR
114.020	010	Molybdenum	EPA 6020		OR
114.020	011	Nickel	EPA 6020		OR
114.020	012	Selenium	EPA 6020		OR
114.020	013	Silver	EPA 6020		OR
114.020	014	Thallium	EPA 6020		OR
114.020	015	Vanadium	EPA 6020		OR
114.020	016	Zinc	EPA 6020		OR
114.103	001	Chromium VI (Hexavalent Chromium)	EPA 7196 A		OR
114.140	001	Mercury	EPA 7470 A	Aqueous Only	OR
114.141	001	Mercury	EPA 7471 A		OR
114.221	001	Cyanide, Total	EPA 9012 A		OR
114.230	001	Sulfides	EPA 9034		OR
114.240	001	Corrosivity - pH Determination	EPA 9040 B	Aqueous Only	OR
114.241	001	Corrosivity - pH Determination	EPA 9045 C		OR
114.250	001	Fluoride	EPA 9056		OR
114.280	001	Organic Lead	HML 939-M		OR

Field of Accreditation: 115 - Extraction Test of Hazardous Waste

115.020	001	Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311		OR
115.040	001	Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312		OR

Field of Accreditation: 116 - Volatile Organic Chemistry of Hazardous Waste

As of 1/25/2021 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Eurofins TestAmerica Denver

Certificate Number: 2513
Expiration Date: 1/8/2022

116.010	000	EDB and DBCP	EPA 8011		OR
116.030	001	Gasoline Range Organics (GRO)	EPA 8015 B		OR
116.080	000	Volatile Organic Compounds	EPA 8260 B		OR
116.080	120	Oxygenates	EPA 8260 B		OR

Field of Accreditation: 117 - Semi-volatile Organic Chemistry of Hazardous Waste

117.010	001	Diesel Range Organics (DRO)	EPA 8015 B		OR
117.110	000	Extractable Organics	EPA 8270 C		OR
117.171	000	Nitroaromatics and Nitramines	EPA 8330 A		OR
117.210	000	Organochlorine Pesticides	EPA 8081 A		OR
117.220	000	PCBs	EPA 8082		OR
117.240	000	Organophosphorus Pesticides	EPA 8141 A		OR
117.250	000	Chlorinated Herbicides	EPA 8151 A		OR
117.280	000	Carbamates	EPA 8321 A		OR

Field of Accreditation: 120 - Physical Properties of Hazardous Waste

120.010	001	Ignitability	EPA 1010		OR
120.070	001	Corrosivity - pH Determination	EPA 9040 B	Aqueous Only	OR
120.080	001	Corrosivity - pH Determination	EPA 9045 C		OR

CALIFORNIA
Water Boards

GAVIN NEWSOM
GOVERNOR

JARED BLUMENFELD
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board

January 25, 2021

Scott Hall
Eurofins TestAmerica Denver
4955 Yarrow Street
Arvada, CO 80002

Dear Scott Hall: Certificate No. 2513

Congratulations! This notice advises that the laboratory named above has been accredited as an environmental testing laboratory pursuant to the provisions of the California Health and Safety Code (HSC) Sections 100825-100920. The analyses for which this laboratory is accredited are indicated on the enclosed "Accredited Fields of Testing" List.

The laboratory's accreditation begins on the date printed on the enclosed certificate. For renewed accreditations, this date is determined by compliance with applicable deadlines. Noncompliance with these deadlines may have resulted in lapse of accreditation.

Be advised, the laboratory may have been denied accreditation for one or more analyses for which it applied due to failure to comply with regulatory requirements for application or accreditation. It is the laboratory's responsibility to review the enclosed list and know for which methods the laboratory has been accredited. This accreditation is a final action of the state board, subject to petition under Health and Safety Code Section 116701 within 30 days. However, if you believe that a FOT has been left off of your accreditation in error, you may submit to ELAP within 30 days of this letter, an "Accreditation Inquiry Request Form" located at www.waterboards.ca.gov/elap identifying any mistakes or errors you believe occurred in your accreditation, which will begin the period in which to file a petition. ELAP will then review all timely submitted "Accreditation Inquiry Request Forms" and will make a final determination which could then petitioned to the State Water Resources Control Board. **Failure to submit a petition to the State Water Resources Control Board or an "Accreditation Inquiry Request Form" to ELAP within 30 days of this letter will prohibit you from obtaining any further review of your accreditation.**

HSC Section 100890 lists the civil penalties for environmental laboratories that perform analyses for state regulatory purposes without a valid certificate.

E. JOAQUIN ESQUIVEL, CHAIR | EILEEN SOBECK, EXECUTIVE DIRECTOR

1001 I Street, Sacramento, CA 95814 | Mailing Address: P.O. Box 100, Sacramento, CA 95812-0100 | www.waterboards.ca.gov

RECYCLED PAPER

Continued accreditation is contingent upon compliance with HSC Sections 100825-100920 and California Code of Regulations, Title 22, Division 4, Chapter 19, Certification of Environmental Laboratories. ELAP reserves the right to take enforcement action, including issuance of civil penalties, or supension and revocation of the laboratory's ELAP certificate, for failure to comply with all applicable regulations, statutes and orders.

Thank you

Christine Sotelo, Chief
California Environmental Laboratory Accreditation Program (CA ELAP)

E. Joaquin Esquivel, chair | Eileen Sobeck, executive director

1001 I Street, Sacramento, CA 95814 | Mailing Address: P.O. Box 100, Sacramento, CA 95812-0100 | www.waterboards.ca.gov

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SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

TESTAMERICA DENVER
4955 Yarrow Street
Arvada, CO 80002
Maria Fayard Phone: 303-736-0166
www.testamericainc.com

ENVIRONMENTAL

Valid To: October 31, 2021 Certificate Number: 2907.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP), and the requirements of the Department of Energy Consolidated Audit Program (DOECAP) as detailed in version 5.3 of the DoD/DOE Quality Systems Manual for Environmental Laboratories), and for the test methods applicable to the Wyoming Storage Tank Remediation Laboratory Accreditation Program, accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.- Electronic Probes (pH, O_2), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, Total Organic Carbon, Total Organic Halide

Parameter/Analyte	**Non-Potable (Water)**	**Solid Hazardous Waste (Water)**	**Solid Hazardous Waste (Solid)**
Metals			
Aluminum	EPA 200.7	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Antimony	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Arsenic	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Barium	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Beryllium	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Boron	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Cadmium	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Calcium	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Chromium	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B

Parameter/Analyte	**Non-Potable (Water)**	**Solid Hazardous Waste (Water)**	**Solid Hazardous Waste (Solid)**
Cobalt	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Copper	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Iron	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Lead	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Lithium	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Magnesium	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Manganese	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Mercury	EPA 245.1	EPA 7470A	EPA 7471A/7471B
Molybdenum	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Nickel	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Potassium	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Selenium	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Silica	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Silicon	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Silver	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Sodium	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Strontium	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Thallium	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Thorium	----------	EPA 6020/6020A/6020B	EPA 6020/6020A/6020B
Tin	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Titanium	EPA 200.7	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Tungsten	----------	EPA 6020/6020A/6020B	EPA 6020/6020A/6020B
Uranium	EPA 200.8	EPA 6020/6020A/6020B	EPA 6020/6020A/6020B
Vanadium	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Zinc	EPA 200.7/200.8	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B	EPA 6010B/6010C/6010D EPA 6020/6020A/6020B
Nutrients			
Nitrate (as N)	By calculation	EPA 300.0 EPA 9056/9056A By Calculation/Nitrate by Calc	EPA 9056/9056A By Calculation/Nitrate by Calc
Nitrate-Nitrite (as N)	EPA 353.2	EPA 300.0 EPA 353.2 EPA 9056/9056A	EPA 9056/9056A
Nitrite (as N)	EPA 353.2 SM 4500-NO_2 B	EPA 300.0 EPA 353.2 EPA 9056/9056A SM 4500-NO_2 B	EPA 353.2 EPA 9056/9056A

Parameter/Analyte	**Non-Potable (Water)**	**Solid Hazardous Waste (Water)**	**Solid Hazardous Waste (Solid)**
Orthophosphate (as P)	----------	EPA 300.0 EPA 9056/9056A	EPA 9056/9056A
Total Phosphorus	EPA 365.1	EPA 6010B/6010C/6010D	EPA 6010B/6010C/6010D
Demands			
Total Organic Carbon	----------	EPA 9060/9060A	EPA 9060/9060A
Total Organic Halides	----------	EPA 9020B	----------
Wet Chemistry			
Alkalinity (Total Bicarbonate, Carbonate, and Hydroxide Alkalinity)	SM 2320B-1997	SM 2320B	SM 2320B
Ammonia	EPA 350.1	EPA 350.1	----------
Biological Oxygen Demand	SM 5210B	SM 5210B	----------
Bromide	----------	EPA 300.0 EPA 9056/9056A	EPA 9056/9056A
Chloride	----------	EPA 300.0 EPA 9056/9056A	EPA 9056/9056A
Chemical Oxygen Demand	EPA 410.4	EPA 410.4	----------
Conductivity	----------	EPA 9050/9050A	EPA 9050/9050A
Cyanide	----------	EPA 9012A/9012B	EPA 9012A/9012B
Ferrous Iron	SM 3500Fe B, D	SM 3500Fe B, D	----------
Fluoride	----------	EPA 300.0 EPA 9056/9056A	EPA 9056/9056A
Flashpoint	----------	EPA 1010A	----------
Hexavalent Chromium	----------	EPA 7196A	EPA 7196A
pH	SM 4500 H+B	EPA 9040B/9040C	EPA 9045C/9045D
Oil and Grease (HEM and SGT-HEM)	----------	EPA 1664A/1664B	EPA 9071B
Percent Moisture	----------	----------	ASTM D2216
Perchlorate	----------	EPA 6860	EPA 6860
Phenols	----------	EPA 9066	----------
Solids, Total	----------	----------	SM 2540B
Solids, Total Suspended	SM 2540D	SM 2540D	SM 2540D
Solids, Total Dissolved	SM 2540C	SM 2540C	SM 2540C
Sulfate	----------	EPA 300.0 EPA 9056/9056A	EPA 9056/9056A
Sulfide, Total	SM 4500S2 D	EPA 9034/SM 4500S2 D	EPA 9034
Sulfide	----------	EPA 9030B	EPA 9030B
Total Kjeldahl Nitrogen	----------	----------	EPA 351.2
Purgeable Organics (Volatiles)			
1,1,1,2-Tetrachloroethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,1,1-Trichloroethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,1,2,2-Tetrachloroethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,1,2-Trichloro-1,2,2-trifluoroethane	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,1,2-Trichloroethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,1-Dichloroethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,1-Dichloroethene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C

Parameter/Analyte	Non-Potable (Water)	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
1,1-Dichloropropene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,2 Dibromoethane (EDB)	EPA 624/624.1	EPA 8260B/8260C EPA 8011	EPA 8260B/8260C EPA 8011
1,2,3-Trichlorobenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,2,3-Trichlorobenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,2,3-Trichloropropane	EPA 624/624.1	EPA 8260B/8260C EPA 8011	EPA 8260B/8260C EPA 8011
1,2,3-Trimethylbenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,2,4-Trichlorobenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,2,4-Trimethylbenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dibromo-3-chloropropane (DBCP)	EPA 624/624.1	EPA 8260B/8260C EPA 8011	EPA 8260B/8260C EPA 8011
1,2-Dichlorobenzene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dichloroethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dichloroethene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dichloropropane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,2-Xylene (o-Xylene)	EPA 624/624.1	EPA 8260B/8260C AK101/OK DEQ GRO	EPA 8260B/8260C AK101/OK DEQ GRO
1,3,5-Trichlorobenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,3,5-Trimethylbenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,3-Dichlorobenzene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,3-Dichloropropane	----------	EPA 8260B/8260C	EPA 8260B/8260C
1,3-Dichloropropene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,4-Dichlorobenzene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
1,4-Dioxane	EPA 624/624.1	EPA 8260B/8260C EPA 8260B/8260C SIM	EPA 8260B/8260C EPA 8260B/8260C SIM
1,4-Isopropyltoluene	----------	EPA 8260B/8260C	EPA 8260B/8260C
1-Chlorohexane	----------	EPA 8260B/8260C	EPA 8260B/8260C
2,2-Dichloropropane	----------	EPA 8260B/8260C	EPA 8260B/8260C
2-Butanone	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
2-Chloro-1,3-butadiene	----------	EPA 8260B/8260C	EPA 8260B/8260C
2-Chloroethyl Vinyl Ether	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
2-Chlorotoluene	----------	EPA 8260B/8260C	EPA 8260B/8260C
2-Hexanone	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
2-Nitropropane	----------	EPA 8260B/8260C	EPA 8260B/8260C
2-Pentanone	----------	EPA 8260B/8260C	EPA 8260B/8260C
4-Chlorotoluene	----------	EPA 8260B/8260C	EPA 8260B/8260C
4-Methyl-2-pentanone (MIBK)	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Acetone	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Acetonitrile	----------	EPA 8260B/8260C	EPA 8260B/8260C
Acetylene	----------	RSK-175	----------
Acetylene Ethane	----------	RSK-175	----------
Acrolein	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Acrylonitrile	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Allyl Chloride	----------	EPA 8260B/8260C	EPA 8260B/8260C
Benzene	EPA 624/624.1	EPA 8260B/8260C AK101/OK DEQ GRO	EPA 8260B/8260C/ AK101/OK DEQ GRO
Benzyl Chloride	----------	EPA 8260B/8260C/8260C	EPA 8260B/8260C/8260C

Parameter/Analyte	Non-Potable (Water)	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Bromobenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
Bromochloromethane	----------	EPA 8260B/8260C	EPA 8260B/8260C
Bromodichloromethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Bromoform	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Bromomethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Butadiene	----------	----------	----------
Carbon Disulfide	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Carbon Tetrachloride	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Chlorobenzene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Chloroethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Chloroform	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Chloromethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Chloroprene	----------	EPA 8260B/8260C	EPA 8260B/8260C
cis-1,2-Dichloroethene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
cis-1,3-Dichloropropene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
cis-1,4-Dichloro-2-butene	----------	EPA 8260B/8260C	EPA 8260B/8260C
Cyclohexane	----------	EPA 8260B/8260C	EPA 8260B/8260C
Cyclohexanone	----------	EPA 8260B/8260C	EPA 8260B/8260C
Dibromochloromethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Dibromochloromethane	----------	EPA 8260B/8260C	EPA 8260B/8260C
Dibromomethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Dichlorodifluoromethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Dichlorodifluoromethane	----------	EPA 8260B/8260C	EPA 8260B/8260C
Dichlorofluoromethane	----------	EPA 8260B/8260C	EPA 8260B/8260C
Diethyl Ether	----------	EPA 8260B/8260C	EPA 8260B/8260C
Di-isopropylether	----------	EPA 8260B/8260C	EPA 8260B/8260C
Ethane	----------	RSK-175	----------
Ethanol	----------	EPA 8260B/8260C	EPA 8260B/8260C
Ethyl Acetate	----------	EPA 8260B/8260C	EPA 8260B/8260C
Ethyl Benzene	EPA 624/624.1	EPA 8260B/8260C AK101/OK DEQ GRO	EPA 8260B/8260C AK101/OK DEQ GRO
Ethyl Methacrylate	----------	EPA 8260B/8260C	EPA 8260B/8260C
Ethyl Tert-Butyl Ether	----------	----------	----------
Ethylene (Ethene)	----------	RSK-175	----------
Gas Range Organics (GRO)	----------	EPA 8015B/8015C/8015D/ AK101/OK DEQ GRO/NWTPH-Gx	EPA 8015B/8015C/8015D/ AK101/OK DEQ GRO/NWTPH-Gx
Hexachlorobutadiene	----------	EPA 8260B/8260C	EPA 8260B/8260C
Hexane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Iodomethane	----------	EPA 8260B/8260C	EPA 8260B/8260C
Isobutyl alcohol (2-Methyl-1-propanol)	----------	EPA 8260B/8260C	EPA 8260B/8260C
Isopropyl Alcohol	----------	EPA 8260B/8260C	EPA 8260B/8260C
Isopropylbenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
m+p-Xylene	EPA 624/624.1	EPA 8260B/8260C AK101/OK DEQ GRO	EPA 8260B/8260C AK101/ K DEQ GRO
Methacrylonitrile	----------	EPA 8260B/8260C	EPA 8260B/8260C
Methane	----------	RSK-175	----------

Parameter/Analyte	**Non-Potable (Water)**	**Solid Hazardous Waste (Water)**	**Solid Hazardous Waste (Solid)**
Methyl Acetate	----------	EPA 8260B/8260C	EPA 8260B/8260C
Methyl Cyclohexane	----------	EPA 8260B/8260C	EPA 8260B/8260C
Methyl Ethyl Ketone (MEK)	----------	EPA 8260B/8260C	EPA 8260B/8260C
Methyl Isobutyl Ketone	----------	EPA 8260B/8260C	EPA 8260B/8260C
Methyl Methacrylate	----------	EPA 8260B/8260C	EPA 8260B/8260C
Methyl Tert-Butyl Ether (MtBE)	EPA 624/624.1	EPA 8260B/8260C OK DEQ GRO	EPA 8260B/8260C OK DEQ GRO
Methylene Chloride	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Naphthalene	EPA 624/624.1	EPA 8260B/8260C OK DEQ GRO	EPA 8260B/8260C OK DEQ GRO
n-Butyl Alcohol	----------	EPA 8260B/8260C EPA 8015B/8015C	EPA 8260B/8260C EPA 8015B/8015C
n-Butylbenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
n-Propylbenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
Pentachloroethane	----------	EPA 8260B/8260C	EPA 8260B/8260C
Propionitrile	----------	EPA 8260B/8260C	EPA 8260B/8260C
sec-Butylbenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
Styrene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
tert-Butyl Alcohol (2-Methyl-2-propanol)	----------	EPA 8260B/8260C	EPA 8260B/8260C
tert-Butylbenzene	----------	EPA 8260B/8260C	EPA 8260B/8260C
Tetrachloroethene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Tetrahydrofuran	----------	EPA 8260B/8260C	EPA 8260B/8260C
Toluene	EPA 624/624.1	EPA 8260B/8260C AK101/OK DEQ GRO	EPA 8260B/8260C AK101/OK DEQ GRO
Total Petroleum Hydrocarbons (TPH)	EPA 1664A/1664B	EPA 1664A/1664B	----------
trans-1,2-Dichloroethene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
trans-1,3-Dichloropropene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
trans-1,4-Dichloro-2-butene	----------	EPA 8260B/8260C	EPA 8260B/8260C
Trichloroethene	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Trichlorofluoromethane	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Vinyl Acetate	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Vinyl Chloride	EPA 624/624.1	EPA 8260B/8260C	EPA 8260B/8260C
Xylenes, Total	EPA 624/624.1	EPA 8260B/8260C AK101/OK DEQ GRO	EPA 8260B/8260C AK101/OK DEQ GRO
Extractable Organics (Semivolatiles)			
1,1-Biphenyl	----------	EPA 8270C/8270D	EPA 8270C/8270D
1,2,4,5-Tetrachlorobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
1,2,4-Trichlorobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
1,2-Dichlorobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
1,2-Diphenylhydrazine	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
1,3,5-Trinitrobenzene	----------	EPA 8270C/8270D	EPA 8270C/8270D
1,3-Dichlorobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
1,3-Dinitrobenzene	----------	EPA 8270C/8270D	EPA 8270C/8270D
1,4-Dichlorobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
1,4-Dinitrobenzene	----------	EPA 8270C/8270D	EPA 8270C/8270D
1,4-Dioxane	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	Non-Potable (Water)	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
1,4-Naphthoquinone	----------	EPA 8270C/8270D	EPA 8270C/8270D
1-Chloronaphthalene	----------	EPA 8270C/8270D	EPA 8270C/8270D
1-Methylnaphthalene	----------	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
1-Naphthylamine	----------	EPA 8270C/8270D	EPA 8270C/8270D
2,2-oxybis(1-chloropropane)	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,3,4,6-Tetrachlorophenol	----------	EPA 8270C/8270D	EPA 8270C/8270D
2,4,5-Trichlorophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,4,6-Tribromophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,4,6-Trichlorophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dichlorophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dimethylphenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dinitrophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dinitrotoluene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,6-Dichlorophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2,6-Dinitrotoluene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2-Acetylaminofluorene	----------	EPA 8270C/8270D	EPA 8270C/8270D
2-Chloronaphthalene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2-Chlorophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2-methyl-4,6-Dinitrophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2-Methylnaphthalene	----------	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
2-Methylphenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2-Naphthylamine	----------	EPA 8270C/8270D	EPA 8270C/8270D
2-Nitroaniline	----------	EPA 8270C/8270D	EPA 8270C/8270D
2-Nitrophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
2-Picoline	----------	EPA 8270C/8270D	EPA 8270C/8270D
2-sec-butyl-4,6-Dinitrophenol	----------	EPA 8270C/8270D	EPA 8270C/8270D
3,3'-Dichlorobenzidine	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
3,3-Dimethylbenzidine	----------	EPA 8270C/8270D	EPA 8270C/8270D
3+4-Methylphenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
3-Methylcholanthrene	----------	EPA 8270C/8270D	EPA 8270C/8270D
3-Nitroaniline	----------	EPA 8270C/8270D	EPA 8270C/8270D
4,6-Dinitro-2-methylphenol	----------	EPA 8270C/8270D	EPA 8270C/8270D
4-Aminobiphenyl	----------	EPA 8270C/8270D	EPA 8270C/8270D
4-Bromophenyl phenyl ether	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
4-chloro-3-Methylphenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
4-Chloroanilene	----------	EPA 8270C/8270D	EPA 8270C/8270D
4-Chlorophenyl phenyl ether	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
4-Nitroaniline	----------	EPA 8270C/8270D	EPA 8270C/8270D
4-Nitrophenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
5-nitro-o-Toluidine	----------	EPA 8270C/8270D	EPA 8270C/8270D
7,12-Dimethylbenz(a)anthracene	----------	EPA 8270C/8270D	EPA 8270C/8270D
Acenaphthene	EPA 625/625.1/625.1	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
Acenaphthylene	EPA 625/625.1	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
Acetophenone	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	Non-Potable (Water)	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Alachlor	----------	EPA 8270C/8270D	EPA 8270C/8270D
alpha-, alpha-Dimethylphenethylamine	----------	EPA 8270C/8270D	EPA 8270C/8270D
Aniline	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Anthracene	EPA 625/625.1	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
Aramite	----------	EPA 8270C/8270D	EPA 8270C/8270D
Atrazine	----------	EPA 8270C/8270D	EPA 8270C/8270D
Azobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Benzaldehyde	----------	EPA 8270C 8270D	EPA 8270C/8270D
Benzidine	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Benzo(a)anthracene	EPA 625/625.1	EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzo(a)pyrene	EPA 625/625.1	EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzo(b)fluoranthene	EPA 625/625.1	EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzo(ghi)perylene	EPA 625/625.1	EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzo(k)fluoranthene	EPA 625/625.1	EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzoic Acid	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Benzyl Alcohol	----------	EPA 8270C/8270D	EPA 8270C/8270D
bis (2-Chloroethoxy) Methane	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
bis (2-Chloroethyl) Ether	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
bis (2-Chloroisopropyl) Ether (2,2'Oxybis(1-chloropropane)	----------	EPA 8270C/8270D	EPA 8270C/8270D
bis (2-Ethylhexyl) Phthalate	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
butyl Benzyl Phthalate	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Caprolactam	----------	EPA 8270C/8270D	EPA 8270C/8270D
Carbazole	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Chlorobenzilate	----------	EPA 8270C/8270D	EPA 8270C/8270D
Chrysene	EPA 625/625.1	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
Cresols	----------	EPA 8270C/8270D	EPA 8270C/8270D
Diallate	----------	EPA 8270C/8270D	EPA 8270C/8270D
Dibenzo (a,h) anthracene	EPA 625/625.1	EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Dibenzofuran	----------	EPA 8270C/8270D	EPA 8270C/8270D
Diesel Range Organics (DRO)	----------	EPA 8015B/8015C/8015D AK102/8015D/OK DEQ DRO/NWTPH-Dx	EPA 8015B/8015C/8015D AK102/8015D/OK DEQ DRO/NWTPH-Dx
Diethyl Phthalate	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Dimethoate	----------	EPA 8270C/8270D	EPA 8270C/8270D
Dimethyl Phthalate	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
di-n-butyl Phthalate	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
di-n-octyl Phthalate	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Dinoseb	----------	EPA 8270C/8270D	EPA 8270C/8270D
Diphenylamine	----------	EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	Non-Potable (Water)	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Disulfoton	----------	EPA 8270C/8270D	EPA 8270C/8270D
Ethyl Methanesulfonate	----------	EPA 8270C/8270D	EPA 8270C/8270D
Famphur	----------	EPA 8270C/8270D	EPA 8270C/8270D
Fluorene	EPA 625/625.1	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
Fluoroanthene	EPA 625/625.1	EPA 8270C/8270D EPA8270D SIM	EPA 8270C/8270D EPA 8270D SIM
Hexachlorobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorobutadiene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorocyclopentadiene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Hexachloroethane	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorophene	----------	EPA 8270C/8270D	EPA 8270C/8270D
Hexachloropropene	----------	EPA 8270C/8270D	EPA 8270C/8270D
Indeno (1,2,3-cd) pyrene	EPA 625/625.1	EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Isodrin	----------	EPA 8270C/8270D	EPA 8270C/8270D
Isophorone	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Isosafrole	----------	EPA 8270C/8270D	EPA 8270 C/8270D
Methapyrilene	----------	EPA 8270C/8270D	EPA 8270C/8270D
Methyl Methane Sulfonate	----------	EPA 8270C/8270D	EPA 8270C/8270D
Motor Oil (Residual Range Organics)	----------	EPA 8015B/8015C/8015D AK103/OK DEQ RRO	EPA 8015B/ 8015C/8015D AK103/ OK DEQ RRO
Naphthalene	EPA 625/625.1	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
Nitrobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Nitroquinoline-1-oxide	----------	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodiethylamine	----------	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodimethylamine	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodi-n-butylamine	----------	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodi-n-propylamine	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodiphenylamine	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosomethylethylamine	----------	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosomorpholine	----------	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosopiperidine	----------	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosopyrrolidine	----------	EPA 8270C/8270D	EPA 8270C/8270D
o,o,o-triethyl Phosphorothioate	----------	EPA 8270C/8270D	EPA 8270C/8270D
o-Toluidine	----------	EPA 8270C/8270D	EPA 8270C/8270D
Parathion, ethyl	----------	EPA 8270C/8270D	EPA 8270C/8270D
Parathion, methyl	----------	EPA 8270C/8270D	EPA 8270C/8270D
p-Dimethylaminoazobenzene	----------	EPA 8270C/8270D	EPA 8270C/8270D
Pentachlorobenzene	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Pentachloroethane	----------	EPA 8270C/8270D	EPA 8270C/8270D
Pentachloronitobenzene	----------	EPA 8270C/8270D	EPA 8270C/8270D
Pentachlorophenol	EPA 625/625.1	EPA 8270C/8270D EPA 8321A/8321B	EPA 8270C/8270D EPA 8321A/8321B
Phenacetin	----------	EPA 8270C/8270D	EPA 8270C/8270D
Phenanthrene	EPA 625/625.1	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM

Parameter/Analyte	**Non-Potable (Water)**	**Solid Hazardous Waste (Water)**	**Solid Hazardous Waste (Solid)**
Phenol	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Phorate	----------	EPA 8270C/8270D	EPA 8270C/8270D
p-Phenylene Diamine	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Pronamide	----------	EPA 8270C/8270D	EPA 8270C/8270D
Pyrene	EPA 625/625.1	EPA 8270C/8270D EPA 8270D SIM	EPA 8270C/8270D EPA 8270D SIM
Pyridine	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Safrole	----------	EPA 8270C/8270D	EPA 8270C/8270D
Sulfotepp	----------	EPA 8270C/8270D	EPA 8270C/8270D
Thionazin	----------	EPA 8270C/8270D	EPA 8270C/8270D
Tributyl phosphate	EPA 625/625.1	EPA 8270C/8270D	EPA 8270C/8270D
Pesticides/Herbicides/PCBs			
2,4,5-T	----------	EPA 8151A EPA 8321A	EPA 8151A EPA 8321A
2,4,5-TP	----------	EPA 8151A EPA 8321A	EPA 8151A EPA 8321A
2,4-D	----------	EPA 8151A EPA 8321A	EPA 8151A EPA 8321A
2,4-DB	----------	EPA 8151A EPA 8321A	EPA 8151A EPA 8321A
4,4'-DDD	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
4,4'-DDE	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
4,4'-DDT	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Aldrin	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
alpha-BHC	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
alpha-Chlordane	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Atrazine	----------	EPA 8141A/8141B	EPA 8141A/8141B
Azinophos ethyl	----------	EPA 8141A/8141B	EPA 8141A/8141B
Azinophos methyl	----------	EPA 8141A/8141B	EPA 8141A/8141B
beta-BHC	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Bolstar	----------	EPA 8141A/8141B	EPA 8141A/8141B
Chlordane (technical)	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Chloropyrifos	----------	EPA 8141A/8141B	EPA 8141A/8141B
Coumaphos	----------	EPA 8141A/8141B	EPA 8141A/8141B
Dalapon	----------	EPA 8151A EPA 8321A	EPA 8151A EPA 8321A
delta-BHC	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Demeton, total	----------	EPA 8141A/8141B	EPA 8141A/8141B
Demeton-O	----------	EPA 8141A/8141B	EPA 8141A/8141B
Demeton-S	----------	EPA 8141A/8141B	EPA 8141A/8141B
Diazinon	----------	EPA 8141A/8141B	EPA 8141A/8141B
Dicamba	----------	EPA 8151A EPA 8321A	EPA 8151A EPA 8321A
Dichloroprop	----------	EPA 8151A EPA 8321A	EPA 8151A EPA 8321A
Dichlorovos	----------	EPA 8141A/8141B	EPA 8141A/8141B
Dieldrin	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Dimethoate	----------	EPA 8141A/8141B	EPA 8141A/8141B

Parameter/Analyte	Non-Potable (Water)	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Dinoseb	----------	EPA 8151A EPA 8321A	EPA 8321A
Disulfoton	----------	EPA 8141A/8141B	EPA 8141A/8141B
Endonsulfan sulfate	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan I	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan II	EPA 608/608.3	EPA 8081A /8081B	EPA 8081A/8081B
Endrin	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Endrin aldehyde	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Endrin ketone	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
EPN	----------	EPA 8141A/8141B	EPA 8141A/8141B
Ethoprop	----------	EPA 8141A/8141B	EPA 8141A/8141B
Ethyl Parathion	----------	EPA 8141A/8141B	EPA 8141A/8141B
Famphur	----------	EPA 8141A/8141B	EPA 8141A/8141B
Fensulfothion	----------	EPA 8141A/8141B	EPA 8141A/8141B
Fenthion	----------	EPA 8141A/8141B	EPA 8141A/8141B
gamma-BHC	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
gamma-Chlordane	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor epoxide	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Hexachlorobenzene	----------	EPA 8081A/8081B	EPA 8081A/8081B
Malathion	----------	EPA 8141A/8141B	EPA 8141A/8141B
MCPA	----------	EPA 8151A EPA 8321A	EPA 8151A EPA 8321A
MCPP	----------	EPA 8151A EPA 8321A	EPA 8151A EPA8321A
Merphos	----------	EPA 8141A/8141B	EPA 8141A/8141B
Methoxychlor	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Methyl parathion	----------	EPA 8141A/8141B	EPA 8141A/8141B
Mevinphos	----------	EPA 8141A/8141B	EPA 8141A/8141B
Naled	----------	EPA 8141A/8141B	EPA 8141A/8141B
o,o,o-Triethylphos Phorothioate	----------	EPA 8141A/8141B	EPA 8141A/8141B
PCB-1016 (Arochlor)	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
PCB-1221	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
PCB-1232	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
PCB-1242	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
PCB-1248	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
PCB-1254	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
PCB-1260	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
PCB-1262	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
PCB-1268	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
Pentachlorophenol	----------	EPA 8151A	EPA 8151A
Phorate	----------	EPA 8141A/8141B	EPA 8141A/8141B
Phosmet	----------	EPA 8141A/8141B	EPA 8141A/8141B
Picrolam	----------	EPA 8151A	EPA 8151A
Propazine	----------	EPA 8141A/8141B	EPA 8141A/8141B
Ronnel	----------	EPA 8141A/8141B	EPA 8141A/8141B
Simazine	----------	EPA 8141A/8141B	EPA 8141A/8141B
Stirophos	----------	EPA 8141A/8141B	EPA 8141A/8141B

Parameter/Analyte	**Non-Potable (Water)**	**Solid Hazardous Waste (Water)**	**Solid Hazardous Waste (Solid)**
Sulfotepp	----------	EPA 8141A/8141B	EPA 8141A/8141B
Thionazin	----------	EPA 8141A/8141B	EPA 8141A/8141B
Tokuthion	----------	EPA 8141A/8141B	EPA 8141A/8141B
Total PCBs	EPA 608/608.3	EPA 8082/8082A	EPA 8082/8082A
Toxaphene	EPA 608/608.3	EPA 8081A/8081B	EPA 8081A/8081B
Trichloronate	----------	EPA 8141A/8141B	EPA 8141A/8141B
Explosives			
1,3,5-Trinitrobenzene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
1,3-Dinitrobenzene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
2,4,6-Trinitrotoluene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
3,5-Dinitroaniline	----------	EPA 8330B EPA 8321A/8321B	EPA 8330B EPA 8321A/8321B
2,4-Dinitrotoluene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
2,4-Diamino-6-nitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
2,6-Dinitroltoluene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
2,6-Diamino-4-nitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
2-amino-4,6-Dinitrotoluene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
2-Nitrotoluene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
3-Nitrotoluene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
4-amino-2,6-Dinitrotoluene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
4-Nitrotoluene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
Nitrobenzene	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
Nitroglycerin	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
Nitroguanidine	----------	EPA 8321A/8321B	EPA 8321A/8321B
HMX (octahydro-1,3,5,7-tetrabitro-1,3,5,7-Tetrazocine)	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
Pentaerythritoltetranitrate (PETN)	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
Picric acid	----------	EPA 8330A/8330B	EPA 8330A/8330B
RDX (hexahydro-1,3,5-trinitro-1,3,5-Triazine)	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
Tetryl (methyl 2,4,6-Trinitrophenylnitramine	----------	EPA 8330A/8330B EPA 8321A/8321B	EPA 8330A/8330B EPA 8321A/8321B
DNX (Hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine)	----------	EPA 8330A/8330B	EPA 8330A/8330B
MNX (Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine)	----------	EPA 8330A/8330B	EPA 8330A/8330B

Parameter/Analyte	**Non-Potable (Water)**	**Solid Hazardous Waste (Water)**	**Solid Hazardous Waste (Solid)**
TNX(hexahydro-1,3,5-trinitroso-1,3,5-triazine)	----------	EPA 8330A/8330B	EPA 8330A/8330B
Explosives LC/MS/MS			
1,3,5-Trinitrobenzene	----------	EPA 8321A/8321B	EPA 8321A/8321B
1,3-Dinitrobenzene	----------	EPA 8321A/8321B	EPA 8321A/8321B
2,4,6-Trinitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
2,4-Dinitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
2,6-Dinitroltoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
2-Amino-4,6-Dinitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
2-Nitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
3-Nitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
4-Amino-2,6-Dinitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
4-Nitrotoluene	----------	EPA 8321A/8321B	EPA 8321A/8321B
DNX (hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine)	----------	EPA 8321A/8321B	EPA 8321A/8321B
MNX (hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine)	----------	EPA 8321A/8321B	EPA 8321A/8321B
Nitrobenzene	----------	EPA 8321A/8321B	EPA 8321A/8321B
Nitroglycerin	----------	EPA 8321A/8321B	EPA 8321A/8321B
Nitroguanidine	----------	EPA 8321A/8321B	EPA 8321A/8321B
HMX (octahydro-1,3,5,7-tetrabitro-1,3,5,7-Tetrazocine)	----------	EPA 8321A/8321B	EPA 8321A/8321B
Pentaerythritoltetranitrate (PETN)	----------	EPA 8321A/8321B	EPA 8321A/8321B
RDX (hexahydro-1,3,5-trinitro-1,3,5-Triazine)	----------	EPA 8321A/8321B	EPA 8321A/8321B
Tetryl (methyl 2,4,6-Trinitrophenylnitramine	----------	EPA 8321A/8321B	EPA 8321A/8321B
TNX (hexahydro-1,3,5-trinitroso-1,3,5-triazine)	----------	EPA 8321A/8321B	EPA 8321A/8321B
Tris(o-cresyl)phosphate	----------	EPA 8321A/8321B	EPA 8321A/8321B
Chemical Warfare Agents			
Thiodiglycol (2,2'-Thiodiethanol)	----------	EPA 8321A/8321B	EPA 8321A/8321B
Hazardous Waste Characteristics			
Conductivity	SM 2510B	EPA 9050A	EPA 9050A
Corrosivity	SM 4500 H+B	EPA 9040B/9040C	EPA 9045C/9045D
Paint filter liquids test	----------	EPA 9095A	EPA 9095A
Synthetic Precipitation Leaching Procedure (SPLP)	----------	EPA 1312	EPA 1312
Toxicity Characteristic Leaching Procedure	----------	EPA 1311	EPA 1311
Turbidity	EPA 180.1	----------	----------
Organic Prep Methods			
Continuous liquid-liquid extraction	----------	EPA 3520C	----------
Microwave extraction	----------	----------	EPA 3546
Separatory funnel liquid-liquid extraction	----------	EPA 3510C	----------
Solid phase extraction	----------	EPA 3535A	----------

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Parameter/Analyte	**Non-Potable (Water)**	**Solid Hazardous Waste (Water)**	**Solid Hazardous Waste (Solid)**
Soxhlet extraction	----------	----------	EPA 3540C
Ultrasonic extraction	----------	----------	EPA 3550B/3550C
Volatiles purge and trap	----------	EPA 5030B	EPA 5030A EPA 5035/5035A
Waste dilution	----------	EPA 3580A	EPA 3580A
Organic Cleanup Procedures			
Florisil Cleanup	----------	EPA 3620B	EPA 3620B
Florisil Cleanup	----------	EPA 3620C	EPA 3620C
Sulfur Cleanup	----------	EPA 3660A	EPA 3660A
Sulfuric Acid/Permanganate Cleanup	----------	EPA 3665A	EPA 3665A
Metals Digestion			
Acid Digestion for Total Metals	----------	EPA 3010A	----------
Acid Digestion for Total Metals	----------	EPA 3020A	----------
Acid Digestion of Sediments, Sludges and Soils	----------	----------	EPA 3050B
Acid Digestion Total Recoverable or Dissolved Metals	----------	EPA 3005A	----------

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, and for the test methods applicable to the Wyoming Storage Tank Remediation Laboratory Accreditation Program), accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

WYOMING STORAGE TANK PROGRAM

Parameter/Analyte	**Method(s)**
Metals	
Cadmium	EPA 6010C/6010D
Chromium	EPA 6010C/6010D
Lead	EPA 6010C/6010D
Wet Chemistry	
Hexavalent chromium	EPA 7196A
Pureable Organics (Volatiles)	
tert-Amyl Methyl Ether	EPA 8260B/8260C
Benzene	EPA 8260B/8260C
tert-Butyl alcohol (2-Methyl-2-propanol)	EPA 8260B/8260C
1,2-Dichloroethane	EPA 8260B/8260C
Di-isopropylether	EPA 8260B/8260C
Ethyl benzene	EPA 8260B/8260C
Ethyl tert-butyl ether	EPA 8260B/8260C
Gas Range Organics (GRO)	EPA 8015B/8015C/8015D

Parameter/Analyte	**Method(s)**
Methyl tert-butyl ether (MTBE)	EPA 8260B/8260C
Naphthalene	EPA 8260B/8260C
Toluene	EPA 8260B/8260C
Xylenes, total	EPA 8260B/8260C
1,2-Xylene	EPA 8260B/8260C
m+p-Xylene	EPA 8260B/8260C
Extractable Organics (Semivolatiles)	
Diesel Range Organics (DRO)	EPA 8015B/8015C/8015D (WY: C10-C32)
Organic Prep Methods	
Volatiles Purge and Trap	EPA 5030B (water) /5030A (solids)

Accredited Laboratory

A2LA has accredited

TESTAMERICA DENVER

Arvada, CO

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP), and the requirements of the Department of Energy Consolidated Audit Program (DOECAP) as detailed in version 5.3 of the DoD/DOE Quality System Manual for Environmental Laboratories (QSM), accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Presented this 12th day of August 2019.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2907.01
Valid to October 31, 2021
Revised March 18, 2020

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

CERTIFICATE OF ENVIRONMENTAL ACCREDITATION

Is hereby granted to

Eurofins TestAmerica St. Louis

13715 Rider Trail North

Earth City, MO 63045

Scope of the certificate is limited to the
"Fields of Testing"
which accompany this Certificate.

Continued accredited status depends on successful completion of on-site inspection, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of
Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **2886**

Expiration Date: **6/30/2021**

Effective Date: **7/1/2020**

Sacramento, California
subject to forfeiture or revocation

Christine Sotelo, Chief
Environmental Laboratory Accreditation Program

CALIFORNIA STATE
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

Eurofins TestAmerica St. Louis

13715 Rider Trail North
Earth City, MO 63045
Phone: 3142988566

Certificate No. **2886**
Expiration Date **6/30/2021**

				Primary Accreditation Body
Field of Testing: 106 - Radionuclides in Drinking Water				
106.010	001	Gross Alpha	EPA 900.0	FL
106.010	002	Gross Beta	EPA 900.0	FL
106.030	001	Radioactive Cesium	EPA 901.1	FL
106.050	002	Radium-226	EPA 903.0	FL
106.060	001	Radium-228	EPA 904.0	FL
106.070	003	Strontium-90	EPA 905.0	FL
106.080	001	Tritium	EPA 906.0	FL
106.092	001	Uranium	EPA 200.8	FL
106.220	001	Strontium-89, 90	DOE Sr-01	FL
106.230	001	Uranium	DOE U-02	FL
106.270	001	Gross Alpha	SM 7110 C	FL
106.610	001	Radon-222	SM 7500-Rn	FL
Field of Testing: 108 - Inorganic Constituents in Non-Potable Water				
108.013	001	Calcium	EPA 200.7 (1994 Rev. 4.4)	FL
108.013	002	Magnesium	EPA 200.7 (1994 Rev. 4.4)	FL
108.013	004	Potassium	EPA 200.7 (1994 Rev. 4.4)	FL
108.013	005	Silica, Dissolved	EPA 200.7 (1994 Rev. 4.4)	LA
108.013	006	Sodium	EPA 200.7 (1994 Rev. 4.4)	FL
108.015	001	Calcium	EPA 200.8 (1994 Rev. 5.4)	LA
108.015	002	Magnesium	EPA 200.8 (1994 Rev. 5.4)	FL
108.015	003	Potassium	EPA 200.8 (1994 Rev. 5.4)	LA
108.015	005	Sodium	EPA 200.8 (1994 Rev. 5.4)	FL
108.017	001	Bromide	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	002	Chloride	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	003	Fluoride	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	004	Nitrate (as N)	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	006	Nitrite (as N)	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	007	Phosphate,Ortho (as P)	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	008	Sulfate (as SO4)	EPA 300.0 (1993 Rev. 2.1)	FL
108.137	001	Hydrogen Ion (pH)	SM 4500-H+ B-2011	FL
Field of Testing: 109 - Metals and Trace Elements in Non-Potable Water				
109.623	001	Aluminum	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	002	Antimony	EPA 200.7 (1994 Rev. 4.4)	FL

As of 7/1/2020 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Eurofins TestAmerica St. Louis

Certificate No.: 2886
Expiration Date: 6/30/2021

109.623	003	Arsenic	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	004	Barium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	005	Beryllium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	006	Boron	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	007	Cadmium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	008	Chromium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	009	Cobalt	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	010	Copper	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	011	Iron	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	012	Lead	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	013	Manganese	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	014	Molybdenum	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	015	Nickel	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	016	Selenium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	017	Silver	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	018	Thallium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	019	Tin	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	020	Titanium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	021	Vanadium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	022	Zinc	EPA 200.7 (1994 Rev. 4.4)	FL
109.625	001	Aluminum	EPA 200.8 (1994 Rev. 5.4)	LA
109.625	002	Antimony	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	003	Arsenic	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	004	Barium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	005	Beryllium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	007	Cadmium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	008	Chromium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	009	Cobalt	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	010	Copper	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	012	Iron	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	013	Lead	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	014	Manganese	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	015	Molybdenum	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	016	Nickel	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	017	Selenium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	018	Silver	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	019	Thallium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	020	Tin	EPA 200.8 (1994 Rev. 5.4)	LA
109.625	021	Titanium	EPA 200.8 (1994 Rev. 5.4)	LA
109.625	022	Vanadium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	023	Zinc	EPA 200.8 (1994 Rev. 5.4)	FL
109.635	001	Mercury	EPA 245.1 (1994 Rev. 3.0)	FL

Eurofins TestAmerica St. Louis

Certificate No.: 2886
Expiration Date: 6/30/2021

Field of Testing: 112 - Radionuclides in Non-Potable Water

112.001	001	Gross Alpha	EPA 900.0		FL
112.001	002	Gross Beta	EPA 900.0		FL
112.003	001	Total Alpha Radium	EPA 903.0		FL

Field of Testing: 114 - Inorganic Chemistry of Hazardous Waste

114.010	001	Antimony	EPA 6010 B		FL
114.010	002	Arsenic	EPA 6010 B		FL
114.010	003	Barium	EPA 6010 B		FL
114.010	004	Beryllium	EPA 6010 B		FL
114.010	005	Cadmium	EPA 6010 B		FL
114.010	006	Chromium	EPA 6010 B		FL
114.010	007	Cobalt	EPA 6010 B		FL
114.010	008	Copper	EPA 6010 B		FL
114.010	009	Lead	EPA 6010 B		FL
114.010	010	Molybdenum	EPA 6010 B		FL
114.010	011	Nickel	EPA 6010 B		FL
114.010	012	Selenium	EPA 6010 B		FL
114.010	013	Silver	EPA 6010 B		FL
114.010	014	Thallium	EPA 6010 B		FL
114.010	015	Vanadium	EPA 6010 B		FL
114.010	016	Zinc	EPA 6010 B		FL
114.020	001	Antimony	EPA 6020		FL
114.020	002	Arsenic	EPA 6020		FL
114.020	003	Barium	EPA 6020		FL
114.020	004	Beryllium	EPA 6020		FL
114.020	005	Cadmium	EPA 6020		FL
114.020	006	Chromium	EPA 6020		FL
114.020	007	Cobalt	EPA 6020		FL
114.020	008	Copper	EPA 6020		FL
114.020	009	Lead	EPA 6020		FL
114.020	010	Molybdenum	EPA 6020		FL
114.020	011	Nickel	EPA 6020		FL
114.020	012	Selenium	EPA 6020		FL
114.020	013	Silver	EPA 6020		FL
114.020	014	Thallium	EPA 6020		FL
114.020	015	Vanadium	EPA 6020		FL
114.020	016	Zinc	EPA 6020		FL
114.103	001	Chromium (VI)	EPA 7196 A	Aqueous Only	FL
114.140	001	Mercury	EPA 7470 A	Aqueous Only	FL
114.141	001	Mercury	EPA 7471 A		FL
114.240	001	Corrosivity - pH Determination	EPA 9040 B	Aqueous Only	FL
114.241	001	Corrosivity - pH Determination	EPA 9045 C		FL

As of 7/1/2020 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Eurofins TestAmerica St. Louis

Certificate No.: 2886
Expiration Date: 6/30/2021

114.250	001	Fluoride	EPA 9056		FL
Field of Testing: 115 - Extraction Test of Hazardous Waste					
115.020	001	Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311		FL
115.021	001	TCLP Inorganics	EPA 1311		LA
115.030	001	Waste Extraction Test (WET)	CCR Chapter11, Article 5, Appendix II		LA
115.040	001	Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312		FL
Field of Testing: 116 - Volatile Organic Chemistry of Hazardous Waste					
116.030	001	Gasoline-range Organics	EPA 8015 B		FL
116.080	000	Volatile Organic Compounds	EPA 8260 B		FL
Field of Testing: 118 - Radionuclides in Hazardous Waste					
118.010	001	Gross Alpha	EPA 9310		FL
118.010	002	Gross Beta	EPA 9310		FL
118.020	001	Radium, Total	EPA 9315		FL
118.030	001	Radium-228	EPA 9320		FL
118.271	001	Strontium	DOE Sr-02		FL
118.290	001	Uranium	DOE U-02		FL
Field of Testing: 120 - Physical Properties of Hazardous Waste					
120.070	001	Corrosivity - pH Determination	EPA 9040 B	Aqueous Only	FL
120.080	001	Corrosivity - pH Determination	EPA 9045 C		FL

As of 7/1/2020 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Eurofins TestAmerica, St. Louis Facility

13715 Rider Trail North
Earth City, Missouri 63045

Fulfills the requirements of

ISO/IEC 17025:2017

and the

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V5.3)

In the field of

TESTING

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 06 April 2022
Certificate Number: L2305

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017 and U.S. DEPARTMENT OF DEFENSE (DoD) QUALITY SYSTEMS MANUAL FOR ENVIRONMENTAL LABORATORIES (DoD QSM V5.3)

Eurofins TestAmerica, St. Louis Facility
13715 Rider Trail North
Earth City, Missouri 63045
Kristen Ely
314-298-8566

TESTING

Valid to: **April 6, 2022** Certificate Number: **L2305**

Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010C/6010D	Aluminum
ICP-AES	EPA 6010B/6010C/6010D	Antimony
ICP-AES	EPA 6010B/6010C/6010D	Arsenic
ICP-AES	EPA 6010B/6010C/6010D	Barium
ICP-AES	EPA 6010B/6010C/6010D	Beryllium
ICP-AES	EPA 6010B/6010C/6010D	Bismuth
ICP-AES	EPA 6010B/6010C/6010D	Boron
ICP-AES	EPA 6010B/6010C/6010D	Cadmium
ICP-AES	EPA 6010B/6010C/6010D	Calcium
ICP-AES	EPA 6010B/6010C/6010D	Chromium
ICP-AES	EPA 6010B/6010C/6010D	Cobalt
ICP-AES	EPA 6010B/6010C/6010D	Copper
ICP-AES	EPA 6010B/6010C/6010D	Iron
ICP-AES	EPA 6010B/6010C/6010D	Lead
ICP-AES	EPA 6010B/6010C/6010D	Lithium
ICP-AES	EPA 6010B/6010C/6010D	Magnesium
ICP-AES	EPA 6010B/6010C/6010D	Manganese

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010C/6010D	Molybdenum
ICP-AES	EPA 6010B/6010C/6010D	Nickel
ICP-AES	EPA 6010B/6010C/6010D	Phosphorus
ICP-AES	EPA 6010B/6010C/6010D	Potassium
ICP-AES	EPA 6010B/6010C/6010D	Selenium
ICP-AES	EPA 6010B/6010C/6010D	Silicon
ICP-AES	EPA 6010B/6010C/6010D	Silver
ICP-AES	EPA 6010B/6010C/6010D	Sodium
ICP-AES	EPA 6010B/6010C/6010D	Strontium
ICP-AES	EPA 6010B/6010C/6010D	Sulfur
ICP-AES	EPA 6010B/6010C/6010D	Thallium
ICP-AES	EPA 6010B/6010C/6010D	Thorium
ICP-AES	EPA 6010B/6010C/6010D	Tin
ICP-AES	EPA 6010B/6010C/6010D	Titanium
ICP-AES	EPA 6010B/6010C/6010D	Vanadium
ICP-AES	EPA 6010B/6010C/6010D	Zinc
GC/MS	EPA 8260B/8260C/8260D	Acetone
GC/MS	EPA 8260B/8260C/8260D	Acetonitrile
GC/MS	EPA 8260B/8260C/8260D	Acrolein
GC/MS	EPA 8260B/8260C/8260D	Acrylonitrile
GC/MS	EPA 8260B/8260C/8260D	Benzene
GC/MS	EPA 8260B/8260C/8260D	Benzyl chloride
GC/MS	EPA 8260B/8260C/8260D	Bromobenzene
GC/MS	EPA 8260B/8260C/8260D	Bromochloromethane
GC/MS	EPA 8260B/8260C/8260D	Bromodichloromethane
GC/MS	EPA 8260B/8260C/8260D	Bromoform
GC/MS	EPA 8260B/8260C/8260D	Bromomethane
GC/MS	EPA 8260B/8260C/8260D	n-Butanol
GC/MS	EPA 8260B/8260C/8260D	2-Butanone
GC/MS	EPA 8260B/8260C/8260D	n-Butylbenzene
GC/MS	EPA 8260B/8260C/8260D	sec-Butylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C/8260D	tert-Butylbenzene
GC/MS	EPA 8260B/8260C/8260D	Carbon disulfide
GC/MS	EPA 8260B/8260C/8260D	Carbon tetrachloride
GC/MS	EPA 8260B/8260C/8260D	Chlorobenzene
GC/MS	EPA 8260B/8260C/8260D	2-Chloro-1,3-butadiene
GC/MS	EPA 8260B/8260C/8260D	Chlorodibromomethane
GC/MS	EPA 8260B/8260C/8260D	Chloroethane
GC/MS	EPA 8260B/8260C/8260D	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/8260C/8260D	Chloroform
GC/MS	EPA 8260B/8260C/8260D	Chloromethane
GC/MS	EPA 8260B/8260C/8260D	Allyl chloride
GC/MS	EPA 8260B/8260C/8260D	2-Chlorotoluene
GC/MS	EPA 8260B/8260C/8260D	4-Chlorotoluene
GC/MS	EPA 8260B/8260C/8260D	Cyclohexane
GC/MS	EPA 8260B/8260C/8260D	Cyclohexanone
GC/MS	EPA 8260B/8260C/8260D	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/8260C/8260D	1,2-Dibromoethane
GC/MS	EPA 8260B/8260C/8260D	Dibromomethane
GC/MS	EPA 8260B/8260C/8260D	1,2-Dichlorobenzene
GC/MS	EPA 8260B/8260C/8260D	1,3-Dichlorobenzene
GC/MS	EPA 8260B/8260C/8260D	1,4-Dichlorobenzene
GC/MS	EPA 8260B/8260C/8260D	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/8260C/8260D	Dichlorodifluoromethane
GC/MS	EPA 8260B/8260C/8260D	1,1-Dichloroethane
GC/MS	EPA 8260B/8260C/8260D	1,2-Dichloroethane
GC/MS	EPA 8260B/8260C/8260D	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/8260C/8260D	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/8260C/8260D	1,1-Dichloroethene
GC/MS	EPA 8260B/8260C/8260D	1,2-Dichloroethene (total)
GC/MS	EPA 8260B/8260C/8260D	1,2-Dichloropropane
GC/MS	EPA 8260B/8260C/8260D	1,3-Dichloropropane
GC/MS	EPA 8260B/8260C/8260D	2,2-Dichloropropane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C/8260D	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/8260C/8260D	trans-1,3-Dichloropropene
GC/MS	EPA 8260B/8260C/8260D	1,1-Dichloropropene
GC/MS	EPA 8260B/8260C/8260D	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260B/8260C/8260D	Dimethyl disulfide
GC/MS	EPA 8260B/8260C/8260D	1,4-Dioxane
GC/MS	EPA 8260B/8260C/8260D	Ethyl acetate
GC/MS	EPA 8260B/8260C/8260D	Ethylbenzene
GC/MS	EPA 8260B/8260C/8260D	Ethyl ether
GC/MS	EPA 8260B/8260C/8260D	Ethyl methacrylate
GC/MS	EPA 8260B/8260C/8260D	Hexachlorobutadiene
GC/MS	EPA 8260B/8260C/8260D	n-Hexane
GC/MS	EPA 8260B/8260C/8260D	2-Hexanone
GC/MS	EPA 8260B/8260C/8260D	Iodomethane
GC/MS	EPA 8260B/8260C/8260D	Isobutanol
GC/MS	EPA 8260B/8260C/8260D	Isopropylbenzene
GC/MS	EPA 8260B/8260C/8260D	p-Isopropyltoluene
GC/MS	EPA 8260B/8260C/8260D	Methacrylonitrile
GC/MS	EPA 8260B/8260C/8260D	Methyl acetate
GC/MS	EPA 8260B/8260C/8260D	Methylcyclohexane
GC/MS	EPA 8260B/8260C/8260D	Methylene chloride
GC/MS	EPA 8260B/8260C/8260D	Methyl methacrylate
GC/MS	EPA 8260B/8260C/8260D	4-Methyl-2-pentanone
GC/MS	EPA 8260B/8260C/8260D	MTBE
GC/MS	EPA 8260B/8260C/8260D	Naphthalene
GC/MS	EPA 8260B/8260C/8260D	2-Nitropropane
GC/MS	EPA 8260B/8260C/8260D	Nonanal
GC/MS	EPA 8260B/8260C/8260D	Pentachloroethane
GC/MS	EPA 8260B/8260C/8260D	Propionitrile
GC/MS	EPA 8260B/8260C/8260D	n-Propylbenzene
GC/MS	EPA 8260B/8260C/8260D	Styrene
GC/MS	EPA 8260B/8260C/8260D	1,1,1,2-Tetrachloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C/8260D	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/8260C/8260D	Tetrachloroethene
GC/MS	EPA 8260B/8260C/8260D	Tetrahydrofuran
GC/MS	EPA 8260B/8260C/8260D	Toluene
GC/MS	EPA 8260B/8260C/8260D	1,3,5-Trichlorobenzene
GC/MS	EPA 8260B/8260C/8260D	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/8260C/8260D	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/8260C/8260D	1,1,1-Trichloroethane
GC/MS	EPA 8260B/8260C/8260D	1,1,2-Trichloroethane
GC/MS	EPA 8260B/8260C/8260D	Trichloroethene
GC/MS	EPA 8260B/8260C/8260D	Trichlorofluoromethane
GC/MS	EPA 8260B/8260C/8260D	1,2,3-Trichloropropane
GC/MS	EPA 8260B/8260C/8260D	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260B/8260C/8260D	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/8260C/8260D	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/8260C/8260D	Vinyl acetate
GC/MS	EPA 8260B/8260C/8260D	Vinyl chloride
GC/MS	EPA 8260B/8260C/8260D	m-Xylene & p-Xylene
GC/MS	EPA 8260B/8260C/8260D	o-Xylene
GC/MS	EPA 8260B/8260C/8260D	Xylenes (total)
GC/MS	EPA 8260B/8260C/8260D SIM	1,4-Dioxane
ICP-MS	EPA 6020/6020A/6020B	Aluminum
ICP-MS	EPA 6020/6020A/6020B	Antimony
ICP-MS	EPA 6020/6020A/6020B	Arsenic
ICP-MS	EPA 6020/6020A/6020B	Barium
ICP-MS	EPA 6020/6020A/6020B	Beryllium
ICP-MS	EPA 6020/6020A/6020B	Bismuth
ICP-MS	EPA 6020/6020A/6020B	Boron
ICP-MS	EPA 6020/6020A/6020B	Cadmium
ICP-MS	EPA 6020/6020A/6020B	Calcium
ICP-MS	EPA 6020/6020A/6020B	Cerium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020/6020A/6020B	Cesium
ICP-MS	EPA 6020/6020A/6020B	Chromium
ICP-MS	EPA 6020/6020A/6020B	Cobalt
ICP-MS	EPA 6020/6020A/6020B	Copper
ICP-MS	EPA 6020/6020A/6020B	Gold
ICP-MS	EPA 6020/6020A/6020B	Hafnium
ICP-MS	EPA 6020/6020A/6020B	Iron
ICP-MS	EPA 6020/6020A/6020B	Lanthanum
ICP-MS	EPA 6020/6020A/6020B	Lead
ICP-MS	EPA 6020/6020A/6020B	Lithium
ICP-MS	EPA 6020/6020A/6020B	Magnesium
ICP-MS	EPA 6020/6020A/6020B	Manganese
ICP-MS	EPA 6020/6020A/6020B	Molybdenum
ICP-MS	EPA 6020/6020A/6020B	Neodymium
ICP-MS	EPA 6020/6020A/6020B	Nickel
ICP-MS	EPA 6020/6020A/6020B	Niobium
ICP-MS	EPA 6020/6020A/6020B	Palladium
ICP-MS	EPA 6020/6020A/6020B	Phosphorus
ICP-MS	EPA 6020/6020A/6020B	Platinum
ICP-MS	EPA 6020/6020A/6020B	Potassium
ICP-MS	EPA 6020/6020A/6020B	Praseodymium
ICP-MS	EPA 6020/6020A/6020B	Rhenium
ICP-MS	EPA 6020/6020A/6020B	Rhodium
ICP-MS	EPA 6020/6020A/6020B	Ruthenium
ICP-MS	EPA 6020/6020A/6020B	Samarium
ICP-MS	EPA 6020/6020A/6020B	Selenium
ICP-MS	EPA 6020/6020A/6020B	Silver
ICP-MS	EPA 6020/6020A/6020B	Sodium
ICP-MS	EPA 6020/6020A/6020B	Strontium
ICP-MS	EPA 6020/6020A/6020B	Tantalum
ICP-MS	EPA 6020/6020A/6020B	Tellurium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020/6020A/6020B	Thallium
ICP-MS	EPA 6020/6020A/6020B	Thorium
ICP-MS	EPA 6020/6020A/6020B	Tin
ICP-MS	EPA 6020/6020A/6020B	Titanium
ICP-MS	EPA 6020/6020A/6020B	Tungsten
ICP-MS	EPA 6020/6020A/6020B	Uranium
ICP-MS	EPA 6020/6020A/6020B	Uranium 233
ICP-MS	EPA 6020/6020A/6020B	Uranium 234
ICP-MS	EPA 6020/6020A/6020B	Uranium 235
ICP-MS	EPA 6020/6020A/6020B	Uranium 236
ICP-MS	EPA 6020/6020A/6020B	Uranium 238
ICP-MS	EPA 6020/6020A/6020B	Vanadium
ICP-MS	EPA 6020/6020A/6020B	Yttrium
ICP-MS	EPA 6020/6020A/6020B	Zinc
ICP-MS	EPA 6020/6020A/6020B	Zirconium
ICP-MS	EPA 6020/6020A/6020B	Total Hardness
ICP-MS	EPA 6020/6020A/6020B	Dysprosium
ICP-MS	EPA 6020/6020A/6020B	Erbium
ICP-MS	EPA 6020/6020A/6020B	Europium
ICP-MS	EPA 6020/6020A/6020B	Gadolinium
ICP-MS	EPA 6020/6020A/6020B	Gallium
ICP-MS	EPA 6020/6020A/6020B	Holmium
ICP-MS	EPA 6020/6020A/6020B	Lutetium
ICP-MS	EPA 6020/6020A/6020B	Rubidium
ICP-MS	EPA 6020/6020A/6020B	Terbium
ICP-MS	EPA 6020/6020A/6020B	Thulium
ICP-MS	EPA 6020/6020A/6020B	Ytterbium
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Cerium
ICP-MS	EPA 200.8	Cesium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Gold
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Phosphorus
ICP-MS	EPA 200.8	Platinum
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Rhodium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Tantalum
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Thorium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Tungsten

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
ICP-MS	EPA 200.8	Zirconium
ICP-AES	EPA 200.7	Aluminum
ICP-AES	EPA 200.7	Antimony
ICP-AES	EPA 200.7	Arsenic
ICP-AES	EPA 200.7	Barium
ICP-AES	EPA 200.7	Beryllium
ICP-AES	EPA 200.7	Bismuth
ICP-AES	EPA 200.7	Boron
ICP-AES	EPA 200.7	Cadmium
ICP-AES	EPA 200.7	Calcium
ICP-AES	EPA 200.7	Chromium
ICP-AES	EPA 200.7	Cobalt
ICP-AES	EPA 200.7	Copper
ICP-AES	EPA 200.7	Iron
ICP-AES	EPA 200.7	Lead
ICP-AES	EPA 200.7	Lithium
ICP-AES	EPA 200.7	Magnesium
ICP-AES	EPA 200.7	Manganese
ICP-AES	EPA 200.7	Molybdenum
ICP-AES	EPA 200.7	Nickel
ICP-AES	EPA 200.7	Phosphorus
ICP-AES	EPA 200.7	Potassium
ICP-AES	EPA 200.7	Selenium
ICP-AES	EPA 200.7	Silicon
ICP-AES	EPA 200.7	Silver
ICP-AES	EPA 200.7	Sodium
ICP-AES	EPA 200.7	Strontium
ICP-AES	EPA 200.7	Sulfur

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 200.7	Thallium
ICP-AES	EPA 200.7	Thorium
ICP-AES	EPA 200.7	Tin
ICP-AES	EPA 200.7	Titanium
ICP-AES	EPA 200.7	Vanadium
ICP-AES	EPA 200.7	Zinc
CVAA	EPA 245.1/7470A	Mercury
Ion Chromatrography	EPA 300.0/9056/9056A	Bromide
Ion Chromatrography	EPA 300.0/9056/9056A	Chloride
Ion Chromatrography	EPA 300.0/9056/9056A	Fluoride
Ion Chromatrography	EPA 300.0/9056/9056A	Nitrate
Ion Chromatrography	EPA 300.0/9056/9056A	Nitrite
Ion Chromatrography	EPA 300.0/9056/9056A	Sulfate
Ion Chromatrography	EPA 300.0/9056/9056A	Ortho-phosphate
Ion Chromatrography	EPA 300.0/9056/9056A	Iodide
Probe	EPA 9040C EPA 150.1 SM 4500-H+ B -2011	pH
Colormetric	EPA 7196A	Hex Chromium
Gas Flow Proportional Counter	EPA 900.0 EPA 9310 SM 7110C	gross alpha/beta
Gas Flow Proportional Counter	ST-RC-0036 ST-RD-0403	Chlorine-36
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 DOE HASL 300 Sr-02 DOE HASL 300 Sr-03	Strontium-90
Liquid Scintillation Counter	SM 7500-Rn B	Radon-222

Non-Potable Water		
Technology	**Method**	**Analyte**
Liquid Scintillation Counter	ST-RC-0079	Selenium-79
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01 HASL 300 Tc-02-RC	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R DOE HASL 300 U-02-RC	Isotopic Uranium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium

Non-Potable Water		
Technology	**Method**	**Analyte**
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Alpha Spectroscopy	ST-RC-0301	Radium-226
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	ST-RC-0210	Polonium-210
Liquid Scintillation Counter	Eichrom Technologies FEW01	Iron-55
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Extraction Chromatography	ST-RC-0058	Strontium-90
Preparation	**Method**	**Type**
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Acid Digestion (Aqueous samples)	EPA 3010A EPA 3005A	Acid Digestion for Metals (Aqueous samples)
Purge & Trap	EPA 5030C	Purge & Trap for Aqueous Volatile
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction

Drinking Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Uranium
Alpha Spectroscopy	DOE HASL 300 U-02-RC	Isotopic Uranium
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	Gross alpha/beta
Gas Flow Proportional Counter	SM 7110C	Gross alpha

Drinking Water		
Technology	**Method**	**Analyte**
Gas Flow Proportional Counter	ST-RC-0036 ST-RD-0403	Chlorine-36
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	SM 7500-Rn B	Radon-222
Liquid Scintillation Counter	ST-RC-0079	Selenium-79
Liquid Scintillation Counter	EPA 906.0	Tritium
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010C/6010D	Aluminum
ICP-AES	EPA 6010B/6010C/6010D	Antimony
ICP-AES	EPA 6010B/6010C/6010D	Arsenic
ICP-AES	EPA 6010B/6010C/6010D	Barium
ICP-AES	EPA 6010B/6010C/6010D	Beryllium
ICP-AES	EPA 6010B/6010C/6010D	Bismuth
ICP-AES	EPA 6010B/6010C/6010D	Boron
ICP-AES	EPA 6010B/6010C/6010D	Cadmium
ICP-AES	EPA 6010B/6010C/6010D	Calcium
ICP-AES	EPA 6010B/6010C/6010D	Chromium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010C/6010D	Cobalt
ICP-AES	EPA 6010B/6010C/6010D	Copper
ICP-AES	EPA 6010B/6010C/6010D	Iron
ICP-AES	EPA 6010B/6010C/6010D	Lead
ICP-AES	EPA 6010B/6010C/6010D	Lithium
ICP-AES	EPA 6010B/6010C/6010D	Magnesium
ICP-AES	EPA 6010B/6010C/6010D	Manganese
ICP-AES	EPA 6010B/6010C/6010D	Molybdenum
ICP-AES	EPA 6010B/6010C/6010D	Nickel
ICP-AES	EPA 6010B/6010C/6010D	Phosphorus
ICP-AES	EPA 6010B/6010C/6010D	Potassium
ICP-AES	EPA 6010B/6010C/6010D	Selenium
ICP-AES	EPA 6010B/6010C/6010D	Silicon
ICP-AES	EPA 6010B/6010C/6010D	Silver
ICP-AES	EPA 6010B/6010C/6010D	Sodium
ICP-AES	EPA 6010B/6010C/6010D	Strontium
ICP-AES	EPA 6010B/6010C/6010D	Sulfur
ICP-AES	EPA 6010B/6010C/6010D	Thallium
ICP-AES	EPA 6010B/6010C/6010D	Thorium
ICP-AES	EPA 6010B/6010C/6010D	Tin
ICP-AES	EPA 6010B/6010C/6010D	Titanium
ICP-AES	EPA 6010B/6010C/6010D	Vanadium
ICP-AES	EPA 6010B/6010C/6010D	Zinc
ICP-MS	EPA 6020/6020A/6020B	Aluminum
ICP-MS	EPA 6020/6020A/6020B	Antimony
ICP-MS	EPA 6020/6020A/6020B	Arsenic
ICP-MS	EPA 6020/6020A/6020B	Barium
ICP-MS	EPA 6020/6020A/6020B	Beryllium
ICP-MS	EPA 6020/6020A/6020B	Bismuth
ICP-MS	EPA 6020/6020A/6020B	Boron
ICP-MS	EPA 6020/6020A/6020B	Cadmium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020/6020A/6020B	Calcium
ICP-MS	EPA 6020/6020A/6020B	Cerium
ICP-MS	EPA 6020/6020A/6020B	Cesium
ICP-MS	EPA 6020/6020A/6020B	Chromium
ICP-MS	EPA 6020/6020A/6020B	Cobalt
ICP-MS	EPA 6020/6020A/6020B	Copper
ICP-MS	EPA 6020/6020A/6020B	Gold
ICP-MS	EPA 6020/6020A/6020B	Hafnium
ICP-MS	EPA 6020/6020A/6020B	Iron
ICP-MS	EPA 6020/6020A/6020B	Lanthanum
ICP-MS	EPA 6020/6020A/6020B	Lead
ICP-MS	EPA 6020/6020A/6020B	Lithium
ICP-MS	EPA 6020/6020A/6020B	Magnesium
ICP-MS	EPA 6020/6020A/6020B	Manganese
ICP-MS	EPA 6020/6020A/6020B	Molybdenum
ICP-MS	EPA 6020/6020A/6020B	Neodymium
ICP-MS	EPA 6020/6020A/6020B	Nickel
ICP-MS	EPA 6020/6020A/6020B	Niobium
ICP-MS	EPA 6020/6020A/6020B	Palladium
ICP-MS	EPA 6020/6020A/6020B	Phosphorus
ICP-MS	EPA 6020/6020A/6020B	Platinum
ICP-MS	EPA 6020/6020A/6020B	Potassium
ICP-MS	EPA 6020/6020A/6020B	Praseodymium
ICP-MS	EPA 6020/6020A/6020B	Rhenium
ICP-MS	EPA 6020/6020A/6020B	Rhodium
ICP-MS	EPA 6020/6020A/6020B	Ruthenium
ICP-MS	EPA 6020/6020A/6020B	Samarium
ICP-MS	EPA 6020/6020A/6020B	Selenium
ICP-MS	EPA 6020/6020A/6020B	Silver
ICP-MS	EPA 6020/6020A/6020B	Sodium
ICP-MS	EPA 6020/6020A/6020B	Strontium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020/6020A/6020B	Tantalum
ICP-MS	EPA 6020/6020A/6020B	Tellurium
ICP-MS	EPA 6020/6020A/6020B	Thallium
ICP-MS	EPA 6020/6020A/6020B	Thorium
ICP-MS	EPA 6020/6020A/6020B	Tin
ICP-MS	EPA 6020/6020A/6020B	Titanium
ICP-MS	EPA 6020/6020A/6020B	Tungsten
ICP-MS	EPA 6020/6020A/6020B	Uranium
ICP-MS	EPA 6020/6020A/6020B	Uranium 233
ICP-MS	EPA 6020/6020A/6020B	Uranium 234
ICP-MS	EPA 6020/6020A/6020B	Uranium 235
ICP-MS	EPA 6020/6020A/6020B	Uranium 236
ICP-MS	EPA 6020/6020A/6020B	Uranium 238
ICP-MS	EPA 6020/6020A/6020B	Vanadium
ICP-MS	EPA 6020/6020A/6020B	Yttrium
ICP-MS	EPA 6020/6020A/6020B	Zinc
ICP-MS	EPA 6020/6020A/6020B	Zirconium
CVAA	EPA 7471A/7471B	Mercury
Ion Chromatrography	EPA 300.0/9056A	Bromide
Ion Chromatrography	EPA 300.0/9056A	Chloride
Ion Chromatrography	EPA 300.0/9056A	Fluoride
Ion Chromatrography	EPA 300.0/9056A	Nitrate
Ion Chromatrography	EPA 300.0/9056A	Nitrite
Ion Chromatrography	EPA 300.0/9056A	Sulfate
Ion Chromatrography	EPA 300.0/9056A	Ortho-phosph
Ion Chromatrography	EPA 300.0/9056A	Iodide
Probe	EPA 9045D	pH
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 DOE HASL 300 Sr-02 DOE HASL 300 Sr-03	Strontium-90
Liquid Scintillation Counter	ST-RC-0079	Selenium-79
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01 HASL 300 Tc-02-RC	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R DOE HASL 300 U-02-RC	Isotopic Uranium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Alpha Spectroscopy	ST-RC-0301	Radium-226
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	Eichrom Technologies FEW01	Iron-55
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Preparation	**Method**	**Type**
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Acid Digestion (solids)	EPA 3050B	Acid Digestion for Metals of Sedimtent/Soils
Purge & Trap	EPA 5030C	Purge & Trap for Aqueous Volatile Samples
Closed System Purge & Trap and Extraction for Volatiles	EPA 5035A	Closed System Purge & Trap and Extraction for Volatiles
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Extraction Chromatography	Eichrom Technologies FEW01	Iron-55
Extraction Chromatography	ST-RC-0058	Strontium-90

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2305.

(b) (4), (b) (6)

[redacted]

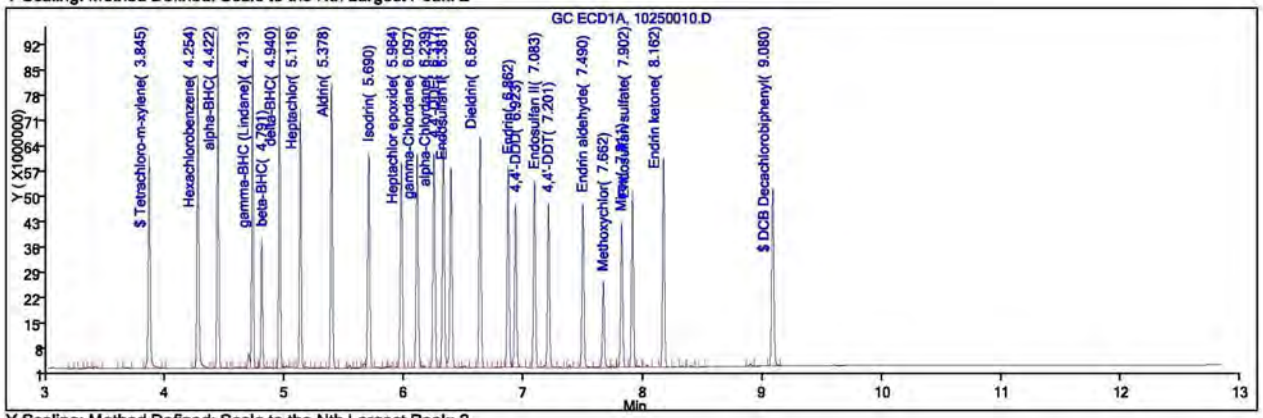
Attachment 1
Example Chromatograms – Columns CLPI & CLPII – AB Standard

Report Date: 28-Oct-2013 05:59:59 Chrom Revision: 2.0 14-Jul-2013 20:56:00

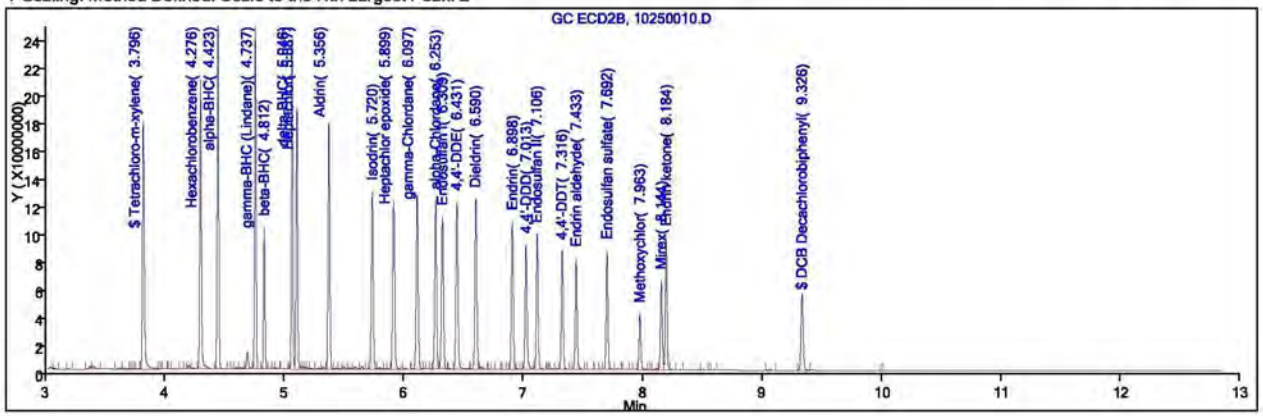
TestAmerica Denver

Data File:	\\Denchrom\ChromData\SGC_P2\20131025-16737.b\10250010.D		
Injection Date:	25-Oct-2013 17:52:49	Limit Group:	GCSV - 8081A
Client ID:		Instrument ID:	SGC_P2
Lims Batch ID:	197873	Lims Sample ID:	10
Operator ID:	DW	Injection Vol:	1.0 ul
Column Type:	CLP1 Pesticides Column 1	Column Dia:	0.32 mm

Y Scaling: Method Defined: Scale to the Nth Largest Peak: 2



Y Scaling: Method Defined: Scale to the Nth Largest Peak: 2



Attachment 5
Example Chromatograms – Columns RxiSil 35-MS & Rxi-XLB – AB Standard

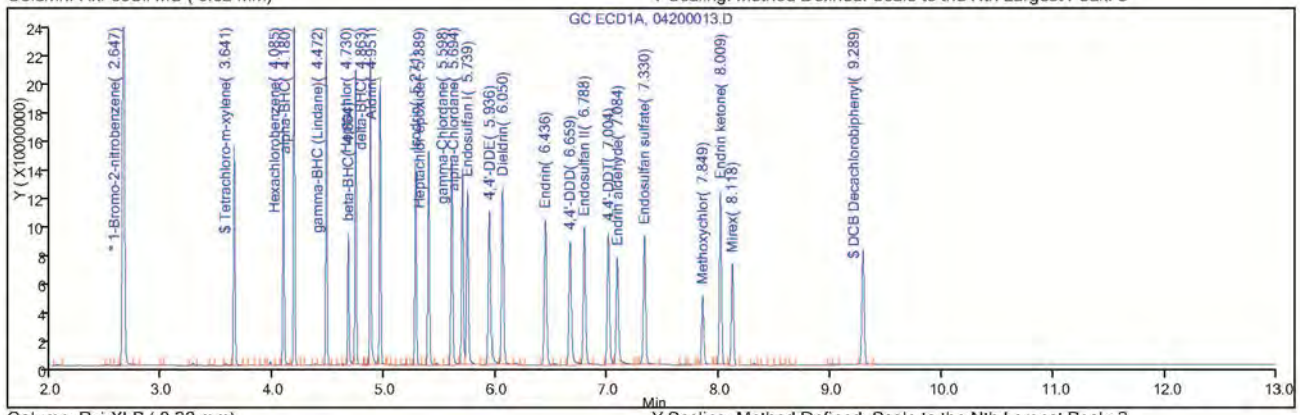
Report Date: 24-Aug-2016 15:23:14 Chrom Revision: 2.2 04-Mar-2016 14:36:24

Preliminary Report

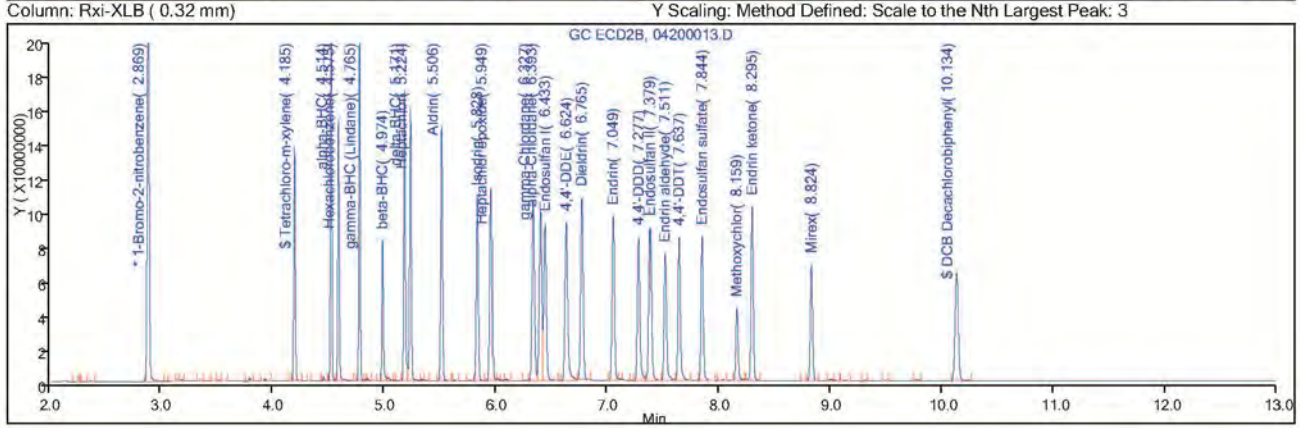
TestAmerica Denver

Data File:	\\ChromNA\Denver\ChromData\SGC_C\20160420-45842.b\04200013.D				
Injection Date:	20-Apr-2016 13:00:18	Instrument ID:	SGC_C	Operator ID:	DAW
Lims ID:	CCVIS AB			Worklist Smp#:	13
Client ID:					
Injection Vol:	1.0 ul	Dil. Factor:	1.0000	ALS Bottle#:	7
Method:	C 8081 IS	Limit Group:	GCSV - 8081A - IS		

Column: Rxi-35Sil MS (0.32 mm) Y Scaling: Method Defined: Scale to the Nth Largest Peak: 3



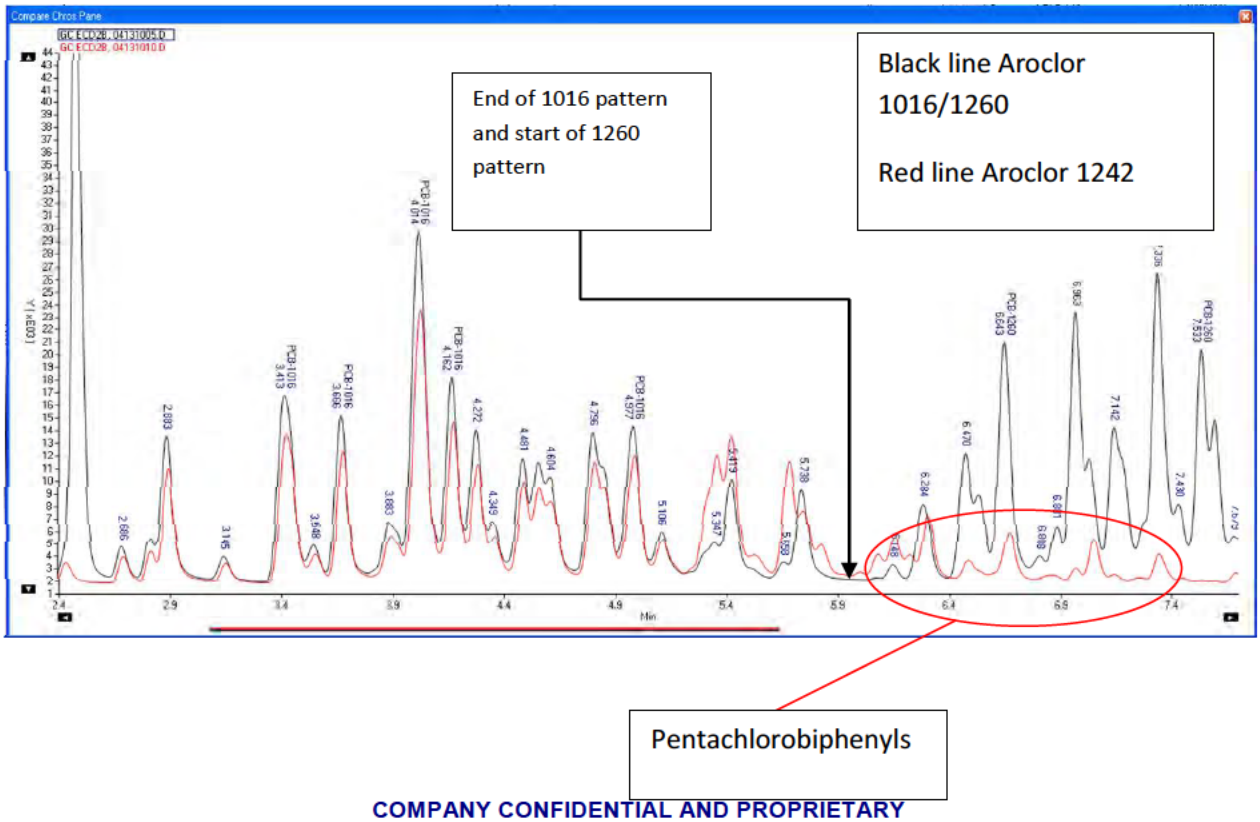
Column: Rxi-XLB (0.32 mm) Y Scaling: Method Defined: Scale to the Nth Largest Peak: 3



Attachment 1. Aroclor Identification 101 (Continued)

The first example considers Aroclor 1016 vs. 1242. Note that the early part of the chromatograms (2.5 – 5.3 minutes) are virtually identical. The key difference is the presence of some later eluting peaks (6.2-7.3 minutes in this chromatogram) in 1242 that are not present in 1016. This difference is masked by the fact that Aroclor 1260 is also present in this standard. Most labs analyze standards of 1016 and 1260 together – there is nothing wrong with this but it is a good idea to periodically (one run with each initial calibration?) analyze them separately so that you have a good idea of the two separate patterns.

The story of 1016 is interesting – in the early 1970's PCBs were starting to be found in fish in the Great Lakes. The more heavily chlorinated biphenyls were bioaccumulating more and were of greatest concern. So, Monsanto attempted to modify the manufacturing process to reduce the amount of pentachlorobiphenyls in Aroclor 1242, while still keeping the overall degree of chlorination similar. They were successful in this regard – Aroclor 1242 has about 10% pentachlorobiphenyls which show up between 6 and 7.4 minutes in the chromatogram below. Aroclor 1016 has 42% by weight chlorine (it does not follow the standard naming convention) but has no pentachlorobiphenyls.



Attachment 2

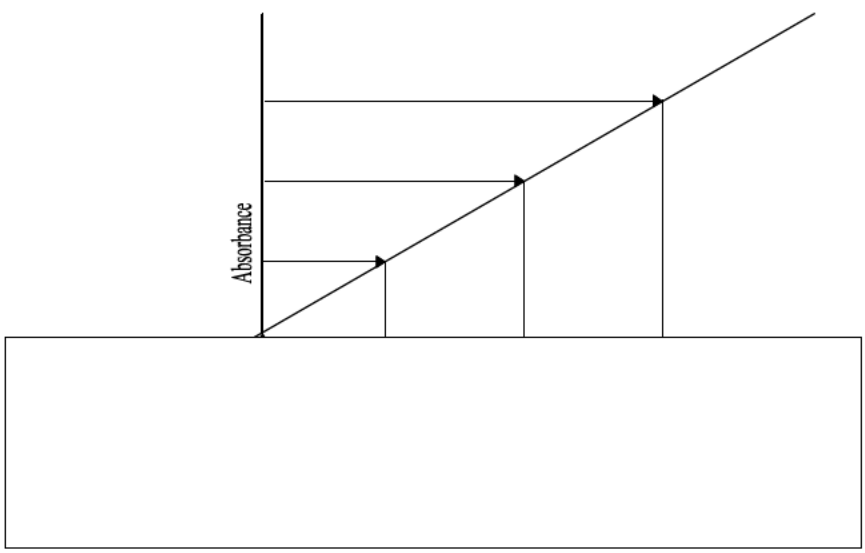
MSA Guidance

Method of Standard Addition

Four equal volume aliquots of sample are measured and known amounts of standards are added to three aliquots. The fourth aliquot is the unknown and no standard is added to it. The concentration of standard added to the first aliquot should be 50% of the expected concentration. The concentration of standard added to the second aliquot should be 100% of the expected concentration and the concentration of standard added to the third aliquot should be 150% of the expected concentration. The volume of the unspiked and spiked aliquots should be the same (i.e., the volume of the spike added should be negligible in relation to the volume of sample).

To determine the concentration of analyte in the sample, the absorbance (or response) of each solution is determined and a linear regression performed. On the vertical axis the absorbance (or response) is plotted versus the concentrations of the standards on the horizontal axis using 0 as the concentration of the unspiked aliquot. An example plot is shown in Figure 1. When the resulting line is extrapolated back to zero absorbance, the point of interception of the horizontal axis is the concentration of the unknown. Calculate the correlation coefficient (r) and the x-intercept (where y=0) of the curve. The concentration in the digestate is equal to the negative x-intercept.

Figure 1



For the method of standard additions to be correctly applied, the following limitations must be taken into consideration.

- The plot of the sample and standards must be linear over the concentration range of concern. For best results, the slope of the curve should be similar to that of a plot of the aqueous standard curve.
- The effect of the interference should not vary as the ratio of the standard added to the sample matrix changes.

STANDARD OPERATING PROCEDURE FOR
DETERMINATION OF ASBESTOS CONTENT OF SERPENTINE AGGREGATE BY
POLARIZED LIGHT MICROSCOPY and POINT COUNTING

SOP No.: 33.308.7
Revised Date: May 6, 2019
Author: Nick Ly

Approved by: Nick Ly, Technical Director

1.0 Scope

1.1 This method provides for the determination of Serpentine aggregate samples for the presence or absence of six types of asbestos: Chrysotile, Amosite, Crocidolite, Anthophyllite, Tremolite and Actinolite in accordance with guidelines promulgated by CARB Method 435 Implementation Guidance Document dated April 2017. This method also provides quantitative determination of asbestos content in accordance with section 8.3 of M435 point counting procedure.

2.0 Method Summary

2.1 A homogenized 100 grams of the original grab sample is removed and pulverized in a mortar and pestle prior to being sifted through a sieve with 200 mesh size (75 micrometers). The refined material is then examined under a low-power stereomicroscope for homogeneity, check for the presence or absence of fibrous constituents follow by preliminary fiber identification using a polarized light microscope (PLM). An asbestiform mineral is defined as having a minimum length to width aspect ratio of at least 3:1 (as defined by M435). Quantification of asbestiform mineral is performed by 400 point counting procedure.

3.0 Apparatus

3.1 Low-power stereomicroscope (10-45x) with light source
3.2 Polarized light microscope with wave retardation plate, 360 degrees graduated rotation stage, substage consenser, lamp and substage iris
3.3 Objective lenses: low power (10x), high power (40x); a medium power (20-25x) and very low power (2-5x) are optional
3.4 Dispersion staining objective lens (central stop)
3.5 Ocular lens (8x minimum)
3.6 Eyepiece reticule: cross hair
3.7 Compensator (wave retardation plate): 550 nanometer (1st order red or gypsum)
3.8 Mortar and pestle

3.9 Metal sieve with a mesh size 200 (75 micrometers)
3.10 Forceps, scalpels, probes
3.11 Microscope slides
3.12 Cover slips
3.13 HEPA-filtered hood
3.14 Tissues and baby wipes
3.15 Glassine paper or clean glass plate
3.16 Index of refraction liquids ND = 1.490-1.720 in increments of 0.002 or 0.004.
3.17 Index of refraction liquids for dispersion staining: high dispersion series, ND = 1.550, 1.605 and 1.680
3.18 Hydrochloric acid
3.19 Organic solvents (THF, Acetone)
3.20 Drying oven

4.0 Sample Preparation

Prior to conducting analysis of a submitted sample, the original material is dried in a drying oven at approximately 100 Celsius to remove any moisture prior to thoroughly homogenizing the material in a sample container. A representative aliquot of 100 grams of the homogenized sample is removed and pulverized in a mortar and pestle to further refine the content prior to being screened through a sieve with 200 mesh size and transfer to a clean sample container. The refined material is then carried through the analytical procedure as specified in section 5.0.

5.0 Analytical Procedure

5.1 Pour a sample on glassine paper and examine under stereomicroscope that is contained in a HEPA-filtered hood. Look for homogeneity, presence or absence of fibers and make a preliminary identification and estimate of fiber content using a PLM.

5.2 Place a drop of 1.550 refractive index liquid onto glass slide. Take pinches of representative materials and put them into the liquid. Tease apart or grind up materials into finer matrix using a metal probe. Cover with a cover slip. Make a minimum of three mounts per sample.

Remarks: Use 1.550 to check for Chrysotile; 1.680 for Amosite and Crocidolite; 1.605 for Tremolite, Actinolite and Anthophyllite.

5.3 Using a polarized light microscope, scan entire area, identifying asbestos, non-asbestos fibers and matrix. Note optical properties of asbestos fibers:
Refractive index (alpha and gamma) using central stop dispersion color in accordance with the method by Shu-Chun Su, sign of elongation, morphology, birefringence, extinction angle, color and pleochroism using plane polarized light, crossed polars and compensator plate for determination of characteristics.

5.4 Note characteristics of asbestos and non-asbestos fibers and report at least one definitive characteristic of the predominant non-asbestos fiber that identifies it as non-asbestos fiber. Record all optical properties in the fields provided in the database. Identification of asbestos fibers can be verified by using the optical properties as provided by NIST Standard Reference Materials 1866a (Chrysotile, Amosite, Crocidolite) and 1867 (Anthophyllite, Tremolite and Actinolite). The accuracy of the asbestos fibers reported can be checked against the acceptable limits as established in the tables outlined in the NIST Certificate of Analysis.

5.5 Visually estimate percentages of asbestos and non-asbestos fiber content based on what was observed under both the stereoscope and PLM microscope. Compare this with prepared slides of known percentages and content of asbestos for accurate estimation.

5.6 Enter macroscopic description of sample, matrix materials, non-asbestos fiber type/percentage and asbestos type/percentage into data base.

5.7 All tools and equipment used around the stereoscope and work area must be wipe cleaned using a moist towel before preparing another sample for analysis. Sample slides, cover slips, disposable glassline paper, and dirty towels shall be disposed in a sealed Ziploc bag inside the sample preparation hood for later disposal.

6.0 Quantitation of Asbestos Content

6.1 Quantitation of the amount of asbestos present is most readily obtained by conducting 400 point counts on the prepared slides. Prepare 8 slides of approximately 5 milligrams of the refined material per sample to be used for asbestos identification and point counting. Count a minimum of 50 points per slide for a total of 400 points per asbestos mineral (LoQ of 0.25% or 0.3% based on 1 asbestos point per 400 total points counted).

6.2 If asbestos is consistently observed, but not counted, report <0.1% asbestos (LoD). Less than 0.1% (<0.1%) amount of asbestos is defined as having at least one asbestos fibers positively identified spreading over three or more sample slides and no point landed on an asbestos fiber during the point count analysis.

6.3 If no asbestos is observed in the sample preparation, report None Detected (0.0%) or No Asbestos Detected.

POINT COUNT PROCEDURE:

1. Sample movement by mechanical stage

   A. Mount prepared sample. Move along the X axis from one side of cover slip to the other. Start at upper left corner of sample.

B. Use micrometer scale on mechanical stage to traverse sample in standard increments across slide. Movement should be standard and large enough to have a new field of view, relative to crosshair or reticle. If no mechanical stage is available on microscope, randomly move the sample slide across the stage.

C. Move standard increment on Y axis. Plan to do 8-10 traverses per slide.

2. Sample counting

A. At cross hair or reticle intersection, determine if space directly superimposed has fiber, matrix or empty space.

B. If fiber at crosshair, analyze by morphology and birefringence to confirm optical properties.

C. Record point as asbestos, matrix (include other fibers in matrix or count separately) or empty space. If an asbestos fiber & matrix particle overlap so that a point is superimposed on their visual intersection a point is scored for both categories.

D. Use a mechanical counter as record of count.

E. Move sample an X increment, observe material at crosshair. Repeat the process

F. Count a minimum of 400 non-empty points to determine whether a sample is greater than 0.25%, i.e. one asbestos point in 400 non-empty points. Count a maximum of 50 points per sample slide. Eight sample slides total.

Calculation of area percent asbestos:

%Asbestos = (# Asbestos/Total # non-empty points) * 100

7.0 Non-Asbestos Fibrous Components

1 Cellulose: Has refractive index similar to chrysotile. Cellulose exhibits pinch and swell characteristics along length, has internal cellular structure and lacks splayed ends. Fibers are not composed of bundles of smaller fibers.

2 Polyethylene fibers: Has morphology and refractive index similar to chrysotile, but will melt when exposed to heat. Has <u>higher birefringence</u> than chrysotile.

3 Vermiculite: Has refractive index and extinction characteristics similar

to chrysotile. May be colored green or brown and look more tabular than fibrous. No fibrils are present.

4 Fibrous talc: Has morphology and refractive index similar to chrysotile, but has a higher birefringence than chrysotile.

5 Glass fibers: Glass, while isotropic, may occasionally refract light in such a way as to mimic the morphology of amosite, but it will not show a sign of elongation under the compensator plate and the index of refraction will be different from amosite.

8.0 Documentation of raw data on optical bench sheet

8.1 All pertinent physical and optical characteristics for fibrous components must be documented on the optical bench sheet. These observations shall be recorded in the following order: sample color, sample texture, homogeneity, fiber morphology, % asbestos under stereo microscope, refractive index (alpha and gamma), fiber color under PLM, pleochroism, birefringence, extinction, sign of elongation, asbestos and non-asbestos fiber type, % asbestos under PLM and bench temperature.

9.0 Quality Control

9.1 Contamination check: Processing blanks such as powdered sugar or asbestos-free material shall be processed alongside regular field samples to check for cross-contamination on a daily basis.

9.2 Microscope Alignment and Refractive Index (RI) Liquid Calibration: Calibration of microscope shall be performed on a daily basis to ensure proper alignment of optics and operation of the microscope. Calibration of RI liquid shall be done when transferring from the stock to the working RI bottles or every 3 months in storage.

9.3 Sample QC duplicate re-analysis: QC duplicate re-analysis of field samples are conducted by a second analyst at a frequency of minimum 1 per 20 samples based on total samples analyzed by the first analyst.

9.4 NIST Standard Reference Materials 1866a (Chrysotile, Amosite, Crocidolite) and 1867 (Anthophyllite, Tremolite and Actinolite). The accuracy of the asbestos fibers reported can be checked against the acceptable limits as established in the tables outlined in the NIST Certificate of Analysis.

9.5 QC samples acceptance criteria

9.5.1 Sample Duplicate: Re-analysis of duplicate samples must have a precision of less than or equal to ($\leq$ 50%). When precision error is greater than 50%, the source of precision error in the sample duplicate must be investigated to determine homogenous nature of the sample

and re-analysis of affected samples be carried out. If additional sample is not available, report findings in narrative.

9.5.2 Reference Sample : Analysis of reference samples must have an accuracy in the range of 50% to 150% recovery rate. When accuracy falls outside of the acceptance limits, the source of accuracy error in the reference sample must be investigated to determine the root cause and re-analysis of affected samples be carried out. If additional sample is not available, report findings in narrative.

10.0 Pollution Prevention

Samples shall be prepared in a clean well ventilated HEPA-filtered sample prep hood with minimal foot traffic or disturbance.

11.0 Waste Management

Samples shall be disposed of in accordance with federal, state and local regulations.

12.0 Equipment Maintenance

Daily and regularly maintenance of PLM using appropriate RI liquid and sample media to verify proper optical alignment and illumination.

13.0 Computer Software and Hardware

Data entry and tabulation are performed using Excel spreadsheet and/or Filemaker database to summarize data entry and generate test reports.

14.0 Troubleshooting

13.1 Check light source for burnt out bulb or fuse if microscope fails to light
13.2 Check and replace light socket or fuse if new bulb fails to light
13.3 Center stage and check optical alignment for proper illumination

15.0 References

Determination of Asbestos Content of Serpentine Aggregate, Implementation Guidance Document, Field Sampling and Laboratory Practices, California Environmental Protection Agency Air Resources Board (CARB) Method 435, Updated April 2017.

Interim Method for the Determination of Asbestos in Bulk Insulation Samples, EPA Test Method 600/M4-82-020, 1982

Method for the Determination of Asbestos in Bulk Building Materials, EPA Test Method 600/R-93/116, July 1993

The Optical Microscopic Identification and Quantification of Bulk Asbestos, E.R. Crutcher.

A Rapid and Accurate Procedure for the Determination of Refractive Indices of Regulated Asbestos, Shu-Chun Su, Hercules Inc. Research Center, 1979-1982

Optical Mineralogy, Kerr, Paul F., 1977.

The Asbestos Particle Atlas, McCrone, Walter, 1980

Revision Record

Revision No.	Date	Parameters	Reviewer Initial
.2	01/10/2013	Added Waste Management and Troubleshooting	NL
.3	01/26/2016	Updated Item 12.0	NL
.4	01/20/2017	Updated Item 4.0	NL
.5	06/27/2017	Updated Analytical Procedure to comply with CARB 435 dated April 2017	NL
.6	07/23/2018	Clarification on mesh size number and particle size per CARB 435 dated April 2017	NL
.7	05/06/2019	Updated section 3.0 and 4.0	NL

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APPENDIX C
HPNS BASEWIDE STOCKPILE INVENTORY
(AS OF JANUARY 1, 2021)

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Stockpile ID	Condition		Comments:
	SAT	UNSAT*	
520D Oily Soil/Oily Debris			
B707 C1-D4			
B707 C4-D1			
B707 C4-D2			
B708 D1			
B707 C4-D4			
Asphalt 500 SA, SU3-A1			
Asphalt 500 SA, SU16			
Asphalt 500 SA, SU15			
Asphalt 79&80, SU1-A1			
Asphalt 520 SA, SU5-A1			
Asphalt B707 A6-D1, A5-D5, A7-D7, A6-D4, A5-D2, A6-D2			
618			
642			
644			
645			
691			
693			
647			
648			
649			
650			
651			
655			
CTO-15 Soil			
Rebar, Wire Mesh and Concrete			Currently Located in Gilbane's RCA
Truck Wash Soils			
Brick Grindings			Currently Located in Gilbane's RCA

*All UNSAT Piles require additional information.

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APPENDIX D
PROJECT WORK INSTRUCTIONS

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WORK INSTRUCTION

Work Instruction:

D0006-4550-010

Revision:

0

Work Instruction Owner:

Aptim Federal Services, LLC HSE

Issuing Authority:

N/A

Approval Date:

9/17/2020

APTIM

RADIOLOGICAL SURVEY OF OVERSIZED DEBRIS

1	Revised to include asphalt	R. Killpack	9/17/2020
0	Initial submittal	B. Rogers	02/04/2020
Rev	**Changes**	**Approved**	**Date**

Parent Document: N/A

APTIM

Work Instruction Number: D0006-4550-010

Revision: 0 **Approval Date: 9/17/2020**

RADIOLOGICAL SURVEY OF OVERSIZED DEBRIS

1.0 PURPOSE

This site-specific work instruction (WI) describes the processes and requirements for the radiological survey of oversized debris encountered during remediation and soil screening activities performed at Hunters Point Naval Shipyard (HPNS). The potential radionuclides of concern within HPNS may include radium-226 (^{226}Ra), cesium-137 (^{137}Cs), and strontium-90 (^{90}Sr), although others may apply and will be identified in the project work plan supported by this work instruction.

AMS-710-07-WI-40121 was written to cover circumstances where surface contamination is known or suspected to be present. This is not expected to be the case at HPNS for these project debris materials. Therefore, for the HPNS projects identified in Section 2.0, this document supersedes the AMS-710-07-WI-40121 survey technique to align the project survey and characterization requirements to the expected radiological risk.

2.0 APPLICATION/SCOPE

This WI applies to any oversized debris (size may vary by project) encountered during remediation and soil screening activities performed at HPNS. This WI shall be used to verify the absence of low-level radiological objects (LLROs) mixed with or embedded in oversized debris and for surface alpha/beta radioactivity greater than project release criteria or project action levels.

This project specific work instruction is developed to support the following projects;

- CTO 5345 Parcel D Removal Site Evaluation Work Plan Section 3.6, “Debris Screening”
- CTO 0024 Parcel E Phase 1 Remedial Action Work Plan Section 6.5.6, “Remediation Approach and Radiological Object Management”
- CTO 4761 Parcel E Phase 3 Remedial Action Work Plan Section 6.5.6, “Remediation Approach and Radiological Object Management”
- CTO 5065 Parcel G Removal Site Evaluation Work Plan, Section 3.6, “Debris Screening”
- CTO 4550 Basewide Radiological Support Work Plan Addendum

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and AMS-710-07-PR-04000, “Radiation Safety Program.”

The following personnel have responsibilities in this WI:

- Project Radiation Safety Officer (PRSO)/Alternate PRSO
- Radiological Control Supervisor (RCS)
- Lead Radiological Control Technician (RCT)
- RCT

APTIM

Work Instruction Number: D0006-4550-010

Revision: 0 **Approval Date: 9/17/2020**

RADIOLOGICAL SURVEY OF OVERSIZED DEBRIS

3.1 Responsibilities

The PRSO is responsible for the maintenance, management, and revision of the WI. The PRSO is also responsible for ensuring RCTs follow this procedure as described herein.

The RCS is responsible for the field oversight of the RCTs performing tasks detailed in this WI.

The lead RCT may be assigned responsibility by the PRSO or RCS for the field oversight at a specific work site for RCTs performing tasks detailed in the WI.

The RCTs are responsible for compliance with this work instruction and for addressing any issues or suggested modifications with the RCS or PRSO.

4.0 TERMINOLOGY

Term	Definition
None	

5.0 REFERENCES

5.1 Required Forms/Checklists

None	

5.2 Other Internal References

AMS-710-07-PR-04000	Radiation Safety Program
AMS-710-07-WI-04005	Radiation Safety Training
AMS-710-07-WI-04009	Radiological Work Permits
AMS-710-07-WI-04012	Radiological Surveys and Monitoring
AMS-710-07-WI-04014	Radiation Detection Instrumentation
AMS-710-07-WI-40121	Performing and Documenting Radiation and Contamination Surveys

5.3 Other External References

CFR, Title 10, Part 20, Standards for Protection against Radiation, U.S. Government Printing Office, Washington, D.C., January 1, 2011, available online at 10CFR20 (current version).

APTIM

Work Instruction Number: D0006-4550-010

Revision: 0 **Approval Date: 9/17/2020**

RADIOLOGICAL SURVEY OF OVERSIZED DEBRIS

6.0 WORK INSTRUCTION

6.1 Prerequisites

Surveys will be performed by an RCT who will be trained on the use of the specific instrumentation and will be aware of proper debris survey process as required by the Project Work Plan and/or the Radiation Protection Plan (RPP).

As low as reasonably achievable principles of time, distance, and shielding are used at all times.

Work activities are performed in accordance with the applicable task-specific Radiological Work Permit (RWP).

Instrumentation used for debris radiological contamination release surveys will be chosen such that the criteria from Regulatory Guide 1.86 can be reliably detected above background levels

Instrumentation used for gamma measurements will be chosen such that they can detect the project specific gamma emitting ROCs on the surveyed surfaces, as needed.

Prior to conducting any surveys, ensure that all survey instrumentation has satisfactorily completed daily function checks and is operating within control limits. Source checks shall be performed at a minimum of once daily, prior to performance of surveys. Daily source check requirements are detailed in AMS-710-07-WI-04014, “Radiation Detection Instrumentation” and other applicable procedures.

Personal Protective Equipment (PPE) should be appropriate for the level of contamination expected and shall be in compliance with both the project applicable Accident Prevention Plan/Site Health and Safety Plan and RWP, if applicable.

6.2 Mechanical Screening and Staging

Oversized debris (larger than 6” in three dimensions) may be mechanically segregated (i.e., screened) from soil in accordance with APTIM project work plans. Debris sizing requirements may vary by project.

Oversized debris will be maintained in or transported to an appropriate screening location and staged until surveyed.

The staged debris will be spread out onto a plastic ground cover within the screening location to minimize the potential of cross contamination between debris and ground surfaces. Debris should be laid out in such a way as to allow 100% accessibility to all material. Debris should not be laid out in layers that exceed approximately 6-inches. The Project RSO will determine if lesser layer thickness is required to develop better material survey accessibility.

6.3 Size Reduction

While size reduction of oversized debris is not expected, it is possible that debris of a non-homogeneous or non-engineered nature may be encountered such as concrete washouts. In the event that debris of this nature is encountered, it will be mechanically size reduced as needed in order to investigate LLROs potentially encased within the debris.

6.4 Asphalt

Durable cover asphalt will be evaluated for its potential for radiological impact. In general, more recently installed asphalt (e.g., within the last five years) is assumed to be not radiologically impacted. At a minimum, a 100% gamma scan of the asphalt will be completed to verify that no LLROs are present. Gamma scan surveys will be performed using a Ludlum 2221 with attached 3-inch x 3-inch Sodium Iodide (NaI) probe, or equivalent. Instrument investigation levels (ILs) will be developed in accordance with the governing project work plan. Once the top surface of the asphalt has been completely scanned, the asphalt will be flipped, and the underside will also be 100% gamma scanned.

If asphalt is determined to be radiologically impacted, release surveys will be performed in a manner similar to other large debris.

6.5 Radiological Survey

Debris that has not been processed through RSY Pad soil screening processes or has otherwise been segregated will be radiologically surveyed prior to being disposed of in accordance with the applicable project work plans.

The following survey techniques will be utilized for debris requiring radiological survey.

- A 100% gamma scan of the oversized debris will be completed to verify that no LLROs are present. LLRO's will be removed and characterized in accordance with the project work plan. Gamma scan surveys will be performed using a Ludlum 2221 with attached 3-inch x3-inch NaI probe, or equivalent. Instrument MDCs and ILs will be developed in accordance with the governing project work plan.
- Following the gamma scan, 25% of oversized debris will be surveyed for fixed and removable contamination.
- A representative 20 static locations and smears will be collected for every 5 cubic yards of debris included within the selected 25% or as directed in project work plans.
- Smears will then be counted for alpha/beta activity and survey documentation prepared prior to the release and disposition of oversized debris. Smears will be counted using a Ludlum Model 2929 or Ludlum Model 3030 sample counter (or equivalent). Instrument MDCs will be developed in accordance with the governing project work plan.

The PRSO will maintain responsibility to revise this survey technique if, while unexpected, Navy program loose surface contamination is detected.

Implementation of this debris survey technique aligns the radiological survey with the pedigree of the material and the established radiological risks associated with the debris. This survey technique is commensurate with the surveys performed on equipment and materials released from restricted areas. Training on this survey technique will be conducted, recorded and maintained in project files.

6.6 Disposition

Disposition of debris shall be managed in accordance with the appropriate project work and waste management plans.

Radioactive materials, including LLROs and radiologically impacted debris, that are identified during screening activities will be collected, segregated, and stored in appropriate containers for subsequent packaging and disposal by a certified waste broker under the direction of the Navy LLRW Disposal Program.

If radiologically-impacted debris cannot be surveyed due to inaccessible surface, or may have internal contamination (e.g., piping), it will be disposed as LLRW.

6.7 Records

Survey records will be maintained as required by the project Work Plan and Radiation Protection Plan. The Navy approvals on the disposition or re-use of oversized debris materials will be maintained in the project records.

Copies of the records generated by this work instruction are maintained on site for the duration of project activities. Original records are periodically transmitted to the Aptim Federal Services, LLC Concord, CA office for storage in the central file system.

7.0 ATTACHMENTS

Attachment	Attachment Title
None	

WORK INSTRUCTION

Work Instruction:

D0006-4550-012

Revision:

0

Work Instruction Owner:

Aptim Federal Services, LLC HSE

Issuing Authority:

N/A

Approval Date:

9/17/2020

APTIM

INVENTORY AND ARCHIVING OF HISTORICAL RADIOLOGICAL SOIL SAMPLES AT HUNTERS POINT NAVAL SHIPYARD

0	Initial submittal.	R. Killpack	9/17/2020
Rev	**Changes**	**Approved**	**Date**

Parent Document: N/A

APTIM

Work Instruction Number: D0006-4550-012

Revision: 0 **Approval Date: 9/17/2020**

INVENTORY AND ARCHIVING OF HISTORICAL RADIOLOGICAL SOIL SAMPLES AT HUNTERS POINT NAVAL SHIPYARD

1.0 PURPOSE

This project-specific work instruction (WI) describes the processes and requirements for identifying, organizing, and archiving historical Hunters Point Naval Shipyard (HPNS) radiological samples which are stored in Building 258. The most common radionuclides of concern (ROCs) within most radiologically restricted areas (RAs) at HPNS which could be encountered at concentrations exceeding background include radium-226 (^{226}Ra), cesium-137 (^{137}Cs), and strontium-90 (^{90}Sr), although other ROCs may apply.

2.0 APPLICATION/SCOPE

This WI applies to historical radiological samples stored within the Radiological Materials Storage Area (RMSA) inside Building 258 at HPNS. Organizing and archiving historical radiological samples will only be conducted in accordance with project work plans and the concurrence of the U.S. Navy.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and AMS-710-07-PR-04000, “Radiation Safety Program.”

The following personnel have responsibilities in this WI:

- Project Radiation Safety Officer (PRSO)/Alternate PRSO
- Radiological Control Supervisor (RCS)
- Lead Radiological Control Technician (RCT)
- RCT

3.1 Responsibilities

The PRSO is responsible for the maintenance, management, and revision of the WI. The PRSO is also responsible for ensuring RCTs follow this procedure as described herein.

The RCS is responsible for the field oversight of the RCTs or other field labor performing tasks detailed in this WI.

The lead RCT may be assigned responsibility by the PRSO or RCS for the field oversight at a specific work site for RCTs or other field labor performing tasks detailed in the WI.

The RCT and other personnel are responsible for compliance with this work instruction and for addressing any issues or suggested modifications with the RCS or PRSO.

APTIM

Work Instruction Number: D0006-4550-012

Revision: 0 **Approval Date: 9/17/2020**

INVENTORY AND ARCHIVING OF HISTORICAL RADIOLOGICAL SOIL SAMPLES AT HUNTERS POINT NAVAL SHIPYARD

4.0 TERMINOLOGY

Term	Definition
None	

5.0 REFERENCES

5.1 Required Forms/Checklists

None	

5.2 Other Internal References

AMS-710-07-PR-04000	Radiation Safety Program
AMS-710-07-WI-04005	Radiation Safety Training
AMS-710-07-WI-04009	Radiological Work Permits
AMS-710-07-WI-04012	Radiological Surveys and Monitoring
AMS-710-07-WI-04014	Radiation Detection Instrumentation
AMS-710-07-WI-40121	Performing and Documenting Radiation and Contamination Surveys

5.3 Other External References

CFR, Title 10, Part 20, Standards for Protection against Radiation, U.S. Government Printing Office, Washington, D.C., January 1, 2011, available online at 10CFR20 (current version).

6.0 WORK INSTRUCTION

6.1 Prerequisites

Surveys will be performed by an RCT who will be trained on the use of the specific instrumentation and will be aware of proper survey technique as contained in any site-specific work instructions and/or the Radiation Protection Plan.

Prior to performing a radiation survey, personnel should review previous survey data and familiarize themselves with possible radiological hazards.

As low as reasonably achievable principles of time, distance, and shielding are always used.

Work activities are performed in accordance with the applicable site- or task-specific Radiological Work Permit (RWP).

Instrumentation used for material and equipment release survey will be chosen such that the values tabled in Regulatory Guide 1.86 can be reliably detected above any background levels.

Prior to conducting any surveys, ensure that all survey instrumentation has satisfactorily completed daily function checks and is operating within control limits. Source checks shall be performed at a minimum of once daily, prior to performance of surveys.

Personal Protective Equipment (PPE) should be appropriate for the level of contamination expected and shall be in compliance with both the applicable Accident Prevention Plan/Site Health and Safety Plan and RWP if applicable.

6.2 Previous Inventory and Archive of Historic Radiological Samples

Historic radiological samples have been collected from Navy contractors performing work within potentially radiologically impacted areas at HPNS for several years. The samples are currently stored inside a RMSA within Building 258. A master list of the chain-of-custodies (COCs) in this area was developed by APTIM in 2017. The samples span numerous years, different parcels, and different onsite contractors. The samples are being held for additional future testing.

6.3 Archiving of Future Radiological Samples

APTIM will construct a new secured storage area in Building 258 to provide storage for the archiving of up to 10,000 additional HPNS samples. To prepare the area, an approximately 2,000 square foot area of Building 258 will be cleared of debris, and the enclosure, which includes a lockable gate door and ceiling panels (if needed, depending on final configuration), will be installed. Heavy-duty steel shelving units will be constructed for storage of samples. Prior to placing samples into the new sample archive area, an initial gamma survey will be performed of the area to document radiation concentrations.

The Navy or Navy contractors shall submit samples to APTIM for archiving. Submission of samples should be coordinated ahead of time to ensure proper receipt of samples. Samples shall be submitted to APTIM with the original COC from the sample collection. If the original COC is not available, APTIM will work with the Navy to generate a separate COC, if required by the Navy. Prior to acceptance of samples, APTIM staff will verify that the submitted sample IDs match the COC.

As samples are stored and archived, APTIM will electronically scan the COC and add the COC file to the electronic file for submittal to the Navy. A paper copy of the COC will also be added to the outside of the sample box for easy identification.

The scanned COCs will be organized by Navy contractor and year in an electronic deliverable to the Navy. A spreadsheet database will be developed and maintained. The spreadsheet database will be organized by Navy contractor and will include the COC number/ID, Sample Date(s), First and Last Sample ID, Sampling/COC Comments, and Notes (as needed).

The sample storage area will be organized by Navy contractor, then by year, and a general reference map of the sample organization will be prepared and updated as needed.

APTIM will provide necessary radiological support when untrained staff or visitors require access to the Building 258 RMSA. This support will include the following:

- As needed, APTIM will provide a briefing to the radiological conditions in the Building 258 RMSA prior to the start of fieldwork. If an extended period of support is needed Radiological Awareness Training may be provided.
- For non-radiological field staff that require Radiological Awareness Training, a dosimeter may be issued.
- APTIM will perform radiological surveys on personnel, materials, and equipment entering and exiting the RMSA, as required. Surveys will be performed in accordance with AMS-710-07-WI-04012, “Radiological Surveys and Monitoring.”
- APTIM radiological surveys performed under this WI will be performed in accordance with the project Radiological Protection Plan, Accident Prevention Plan/Site Safety and Health Plan, and applicable WIs. If levels of radioactivity greater than RWP-expected conditions are identified, temporary suspension of activities in the affected area is required, and the PRSO will be immediately notified.

With written Navy approval, APTIM will release samples under COC. In addition to electronic records within the project files, hard copy records of sample release will be maintained within the sample box.

6.4 Records

Survey records will be maintained as required by the project Work Plan and Radiation Protection Plan.

Copies of the records generated by this WI are maintained on site for the duration of project activities. Original records are periodically transmitted to the APTIM Federal Services, LLC Concord, CA office for storage in the central file system.

7.0 ATTACHMENTS

Attachment	Attachment Title
None	

WORK INSTRUCTION

Work Instruction:

D0006-4550-013

Revision:

0

Work Instruction Owner:

Aptim Federal Services, LLC HSE

Issuing Authority:

N/A

Approval Date:

9/17/2020

APTIM

RSY PAD CONSTRUCTION AND SOIL PROCESSING

0	Initial submittal.	L. Bercik	9/17/2020
Rev	**Changes**	**Approved**	**Date**

Parent Document: N/A

APTIM

Work Instruction Number: D0006-4550-013

Revision: 0 **Approval Date: 9/17/2020**

RSY PAD CONSTRUCTION AND SOIL PROCESSING

1.0 PURPOSE

The purpose of this work instruction (WI) is for radiological screening yard (RSY) pad construction and soil processing. This WI does not include chemical characterization sampling, offsite transportation and disposal of waste, and deconstruction of the RSY pad. This WI supplements APTIM's *Work Plan Addendum, Basewide Radiological Support, Hunters Point Naval Shipyard, CA* (2020).

2.0 APPLICATION/SCOPE

This procedure describes the appropriate methods for constructing a RSY pad and radiologically processing the soil.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and AMS-710-07-PR-04000, "Radiation Safety Program."

The following personnel have responsibilities in this WI:

- Project Radiation Safety Officer (PRSO)/Alternate PRSO
- Radiological Control Technician (RCT)

3.1 Responsibilities

The PRSO is responsible for the maintenance, management, and revision of this work instruction. The PRSO is also responsible for ensuring workers comply with the requirements of this WI.

The RCT is responsible for compliance with this work instruction and for addressing any issues or suggested modifications with the PRSO. The RCT performs gamma surveys and soil sampling in accordance with this WI.

4.0 TERMINOLOGY

Term	Definition
None	

5.0 REFERENCES

5.1 Required Forms/Checklists

None	

5.2 Other Internal References

AMS-710-07-PR-04000	Radiation Safety Program
AMS-710-07-WI-04005	Radiation Safety Training
AMS-710-07-WI-04009	Radiological Work Permits
AMS-710-07-WI-04012	Radiological Surveys and Monitoring
AMS-710-07-WI-04014	Radiation Detection Instrumentation
AMS-710-07-WI-40121	Performing and Documenting Radiation and Contamination Surveys
SPL-SOP-8.10.2	Radiation Monitoring Instrumentation

5.3 Other External References

CFR, Title 10, Part 20, Standards for Protection against Radiation, U.S. Government Printing Office, Washington, D.C., January 1, 2011, available online at 10CFR20 (current version).
U.S. Atomic Energy Commission, Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, Table 1.

6.0 WORK INSTRUCTION

6.1 Prerequisites

Staff performing this procedure must be trained and qualified per AMS-710-07-WI-04005, “Radiation Safety Training.”

Gather appropriate information and supplies, such as the following:

- Historical survey data, recent survey information, if available, and any other information that would be useful to perform a proper survey.
- General survey report form (or equivalent), map of the area to be surveyed (if applicable), gloves, appropriate smears and instruments, plastic bags and labels (as needed), and a marker or pen.

Required personal protective equipment must be in accordance with the RPP, RWP (if required), and Job Safety Analysis document covering the specific work or area.

Check instruments for operability, such as battery check and high voltage check. Verify that the instrument calibration is current.

Review and sign applicable RWP(s) for the specific work area, task, or job.

Comply with general industrial safety standards, including those found in the Job Safety Analysis while conducting surveys.

6.2 Radiological Screening Yard Construction

If no existing RSY pads are available for use, pads will be constructed at the direction of the Navy.

Prior to constructing the pad, a gamma scan and appropriate gamma static survey will be conducted of the underlying ground surface to establish a baseline and to determine if the ambient gamma radiation levels will interfere with the RSY pad operations. If the baseline gamma scan and gamma static survey of the ground surface identifies areas where the count rate exceeds the instrument-specific IL, the area will be flagged. Flagged areas may be further investigated by spectral analysis using the RS_700, or equivalent, or by soil sampling, if the ground surface is soil. If results indicate ROC concentrations above the critical level (for spectral analysis) or release criteria (for soil samples), appropriate remediation or relocation of the RSY pad may be necessary and will be determined in consultation with the Navy.

Once the RSY area has been cleared of potential material generating elevated gamma scanning measurements (if any), the RSY pad will be constructed and surveyed as follows:

- Area will be covered with 10-mil plastic sheeting (or equivalent).
- Perimeter of the RSY pads will be bermed with straw wattles (or equivalent) placed underneath the plastic sheeting to prevent run-on and run-off during precipitation events.
- If the existing surface is uneven and/or consists of materials with different radiological characteristics (e.g., soil and asphalt), a 6-inch-thick layer of clean import fill, and/or rock (or equivalent) will be laid across the plastic. The leveling material will be visually inspected to ensure it's free of debris/organic matter and of sufficient clay content to be readily compactable. If the existing surface is even and consists of similar materials, a leveling layer will not be used.
- If used, the leveling soil layer will be compacted via a minimum of four passes with an excavator or similar tracked machine. This will prevent damage to the plastic sheeting when the excavated soil is added or removed.
- If a leveling layer is used, a baseline radiological survey of the constructed RSY pad will be performed prior to the initial placement of excavated soil and a layer of plastic sheeting will be placed on the leveling soil later to prevent cross-contamination from the placement of excavated soil.
- If no leveling layer is used, excavated material may be placed directly on the plastic liner to build the first layer of the RSY pad

A post-use gamma scan survey will be performed post deconstruction.

6.3 Radiological Soil Screening

Excavated soil will be spread to an even thickness of approximately 6 or 9 inches across an RSY pad. If a Ludlum 44-20 gamma scintillation detector is used to perform gamma scanning, a maximum soil thickness of 6 inches will be used. If the RS-700 gamma scanning system is used, a maximum soil thickness of 9 inches will be used. Once spread, the soil will undergo gamma scan and static surveys, biased soil sampling as needed, and systematic soil sampling for off-site gamma spectroscopy analysis. The systematic soil radiological sampling process is described in the project-specific Sampling and Analysis Plan (SAP) and Section 6.4 of this WI.

The radiological surveying of soil on the RSY pad is performed in two stages. The first stage is a gamma scan conducted over 100 percent of the area. The data collected during the gamma scan will be evaluated and if all readings are below the instrument-specific gamma scan IL, the second stage will not be required.

If the count rate exceeds the instrument-specific scan IL, the second stage requires an additional survey and possible soil sampling at the location and adjacent area where the count rate exceeded the instrument-specific scan IL. The second stage consists of reacquiring the elevated gamma count rate scan location and conducting a one-minute static count. The nearby area will be rescanned to assess if the elevated reading is the result of a point source or distributed radioactive material. If the static (one minute) gamma count rate is less than the instrument-specific static IL and there is no evidence of a point source, further investigation is not required.

Radiological surveys and sample results will be compiled and summarized for Navy review and concurrence prior to designating any material as non-LLRW. If the gamma count rate instrument-specific static IL is exceeded or there is evidence of distributed contamination at or above either scan or static IL, a biased soil sample will be collected and analyzed as appropriate to confirm designation as LLRW or low-level mixed waste.

Surface soil samples will be collected from the RSY pad on a systematic sampling grid to determine disposal requirements for the soil. The quantity of surface soil samples collected will be based on the MARSSIM (NRC et al., 2000) calculation for number of samples as described in Section 6.4 of this WI.

To minimize disposal of waste soil as LLRW, the RSY pad may be subdivided into zones to manage and track smaller volumes of soil at the discretion of the PRSO. Following the collection of radiological samples from each known elevated zone of the RSY pad, soil may be segregated (by zone/area) into small, separate staging piles pending analytical results. If analytical results indicate that the ROC concentration in the staged soil from one zone is greater than the project screening criterion, then only soil from the RSY zone from which it originated will be disposed as LLRW. Soil in staging areas from other zones will be disposed of by others at an appropriate off-site disposal facility if analytical results indicate that the ROC concentration in the soil is determined to be indistinguishable from background based on statistical analysis. Chemical waste characterization and transport and disposal of the excavated material are not included in this task.

Following completion of gamma scan surveys, investigation/remediation of potential radiological anomalies, and collection of radiological soil samples, the surveyed layer on the RSY pad will be covered with Gorilla Snot® or otherwise stabilized to protect against rain and to mitigate the generation of dust.

6.4 Establishing the Number of Soil Samples

Section 5.5.2.2 of the MARSSIM (NRC et al., 2000) defines the method for calculating the number of soil samples when the contaminant is present in background. The RSY pad will be treated in the same manner as a survey unit. Therefore, determining the number of samples will be based on the following factors:

- Screening criterion for ^{226}Ra in soil (upper boundary of the gray region)
- Lower boundary of the gray region (LBGR)

- Relative shift in the ^{226}Ra concentration
- Probability (P_r) that a random measurement from the RSY pad exceeds a random measurement from the background reference area by less than the screening criterion when the median concentration of ^{226}Ra in the RSY pad soil is equal to the LBGR above background
- Decision error percentiles for making a false positive or false negative decision that the mean ^{226}Ra concentration exceeds the screening criterion
- RSY pads are Class 1 survey units receiving 100 percent gamma scan surveys and are less than 1,000 square meters (m^2)

The ^{226}Ra screening criterion is defined as 1 pCi/g plus background. The background ^{226}Ra concentration is 0.861 pCi/g in soil samples collected from the recent HPNS background study (CH2M Hill, Inc., 2020).

MARSSIM (EPA et al., 2000) defines a gray region as the range of values in which the consequences of decision error on whether the ^{226}Ra concentration is less than or exceeds the RG are relatively minor. The RG of 1 pCi/g of ^{226}Ra above background (0.861 pCi/g) was selected to represent the UBGR (1.861 pCi/g). the LBGR is the median concentration in the SU, and the retrospective power will be determined after the survey is completed. Given the absence of data prior to performing the investigation activities, MARSSIM Section 2.5.4 suggests arbitrarily selecting the LBGR as half the RG. Therefore, for this example, the LBGR = 0.5 pCi/g + 0.861 pCi/g = 1.361 pCi/g. Assuming the UBGR equals the RG, then Δ = 0.5 pCi/g for this example. MARSSIM (EPA et al., 2000) defines σ as an estimate of the standard deviation of the measured values in the SU. Because data will not be available until the investigation activities are completed, MARSSIM recommends using the standard deviation of the RBA as an estimate of σ. Of the four possible reference background areas presented in *Final Background Soil Study Report, Base Realignment and Closure Program Management Office West, Former Hunters Point Naval Shipyard, San Francisco, California* (CH2M Hill, Inc., 2020), the largest σ of 0.268 is conservatively used for this example.

The relative shift is calculated based on MARSSIM Section 5.5.2.2 (EPA et al., 2000):

$$\frac{\Delta}{\sigma} = \frac{(UBGR - LBGR)}{\sigma} = \frac{(RG - LBGR)}{\sigma} = \frac{(1.861 - 1.361)}{0.268} = 1.9$$

The minimum number of samples assumes the ^{226}Ra concentration in the SU exceeds the RG. Type I decision error is deciding that the ^{226}Ra concentration in the SU is less than the RG when it actually exceeds the RG. To minimize the potential for releasing soil with concentrations above the RG, the Type I decision error rate is set at 0.05. Type II decision error is deciding that the ^{226}Ra concentration exceeds the RG when it is actually less than the RG. To protect against remediating soil with concentrations below the RG, the Type II decision error rate is set at 0.05.

MARSSIM Table 5.3 (EPA et al., 2000) lists the minimum number of samples to be collected in each SU and RBA based on the relative shift and decision error rates. For a relative shift of 1.9, with a Type I decision error rate of 0.05 and a Type II decision error rate of 0.05, MARSSIM Table 5.3 recommends a minimum of 13 samples in each SU and RBA.

Section 5.5.2.5 of the MARSSIM (NRC et al., 2000) states that the soil sampling locations should be positioned throughout the SU by first randomly selecting a start point and establishing a systematic pattern; this systematic sampling grid may be either triangular or square. The triangular grid is selected because it is generally more efficient for locating small areas of elevated activity.

The sampling locations are positioned throughout the SU by randomly selecting a start point and establishing a systematic triangle grid pattern. The technical and mathematical basis supporting the higher efficiency for a triangular grid is in Appendix D of the MARSSIM (NRC et al., 2000).

The spacing, L, of the systematic triangular grid pattern is given by Equation 5-5 in the MARSSIM and as shown in the following equation.

$$L = \sqrt{\frac{A}{0.866 \times n}}$$

Where:

A = area in square meters of the SU

n = number of surface soil samples to be collected from the SU

For this project, random-start triangular systematic grids for systematic sampling will be developed for each SU using Visual Sample Plan: A Tool for Design and Analysis of Environmental Sampling (Pacific Northwest National Laboratory, 2013). Grid coordinates will be mapped in the field using a Trimble Geo XH GPS receiver or equivalent.

6.5 Reporting

Following receipt of analytical data from the laboratory, RSY data packages will be prepared and submitted to the Navy for review and acceptance. The RSY data packages will include a discussion of the location/origin of the material; summary of scanning and static measurement results; discussion of analytical results, including the range of reported results, minimum detection levels, and comparison with project release, and graphical plots of scan data, systematic and biased samples, and any areas of remediation as applicable.

7.0 ATTACHMENTS

Attachment	Attachment Title
None	

WORK INSTRUCTION

Work Instruction Title:	**D2005-0008-001 - Material and Equipment Release Surveys**	**CMS Number:**	**N/A**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

D2005-0008-001
MATERIAL AND EQUIPMENT RELEASE SURVEYS

0	Initial submittal.	JRH	
Rev	**Changes**	**Approved**	**Date**

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D2005-0008-001
Material and Equipment Release Surveys

CMS Number:	Revision:	Approval Date:
N/A	0	

1.0 PURPOSE

This work instruction describes the methods of surveying equipment, materials (including concrete, asphalt, miscellaneous debris, etc.) or vehicles for release for unrestricted use.

2.0 APPLICATION

This work instruction applies to all site personnel responsible for the unrestricted release of equipment and materials used in a radiologically controlled area.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

3.1 The following personnel have responsibilities in this WI:

- Project/Program Radiation Safety Officer (PRSO)
- Radiological Control Supervisor (RCS)
- Lead Radiological Control Technician
- Radiological Control Technician

3.2 Responsibilities

3.2.1 The PRSO is responsible for the maintenance, management, and revision of this work instruction. The PRSO is also responsible for ensuring workers comply with the requirements of this WI.

3.2.2 The RCS is responsible for the field oversight of the radiological control technician (RCT) performing tasks detailed in this WI.

3.2.3 The lead RCT may be assigned responsibility by the PRSO or RCS for the field oversight at a specific work site of RCTs performing tasks detailed in this WI.

3.2.4 The RCT is responsible for compliance with this work instruction and for addressing any issues or suggested modifications with the RCS or PRSO.

4.0 REFERENCES

CFR, Title 10, Part 20, Standards for Protection against Radiation, U.S. Government Printing Office, Washington, D.C., January 1, 2011, available online at 10CFR20 (current version).

CMS-710-07-PR-04000, *Radiation Safety Program*

CMS-710-07-PR-04005, *Radiation Safety Training*

CMS-710-07-PR-04011, *Radiological Surveys and Monitoring*

CMS-710-07-PR-04013, *Radiation Detection Instrumentation*

CMS-710-07-WI-04008, *Radiological Work Permits*

CMS-710-07-WI-40111, *Performing and Documenting Radiation and Contamination Surveys*

CMS-710-07-FM-40111, *Radiological Survey Forms,* example

SPL-SOP-8.10.2*, Radiation Monitoring Instrumentation*

U.S. Atomic Energy Commission, Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, Table 1.

5.0 WORK INSTRUCTION

5.1 Prerequisites

D2005-0008-001
Material and Equipment Release Surveys

CMS Number:	Revision:	Approval Date:
N/A	0	

5.1.1 Surveys will be performed by an RCT who will be trained on the use of the specific instrumentation and will be aware of proper survey technique as contained in any site specific work instructions and/or the Sitewide Radiation Protection Plan

5.1.2 Prior to performing a radiation survey, personnel should review previous survey data and familiarize themselves with possible radiological hazards.

5.1.3 As low as reasonably achievable principles of time, distance, and shielding are used at all times.

5.1.4 Work activities are performed in accordance with the applicable site- or task-specific Radiological Work Permit (RWP).

5.1.5 Instrumentation used for material and equipment release survey will be chosen such that the values tabled in Regulatory Guide 1.86 can be reliably detected above any background levels.

5.1.6 Prior to conducting any surveys, ensure that all survey instrumentation has satisfactorily completed daily function checks and is operating within control limits. Function checks shall be performed twice daily, once in the morning and once at the end of the day. Daily function check requirements are detailed in SPL-SOP-8.10.2, *Radiation Monitoring Instrumentation*.

5.1.7 Verify the minimum detectable activity (MDA) has been calculated for the selected instrument, if appropriate, and is less than the site release limit. The MDA for all instrumentation, used for conducting unrestricted release surveys, must be less than the site release criteria (RG 1.86 tabled values).

5.1.8 Personal Protective Equipment (PPE) should be appropriate for the level of contamination expected and shall be in compliance with both the applicable Site Health and Safety Plan and Radiological Work Permit if applicable.

5.2 Equipment and Material General Survey Protocol

Clearance and release of equipment and material will be performed through routine scans and measurements as contained in approved processes including MARSAME. Material best analyzed by volumetric measurement methods, (i.e. dirt, asphalt rubble, cement rubble) will be analyzed for radioactive material content by an accredited, offsite laboratory.

5.3 Survey of Material and Equipment

5.3.1 Prior to surveying verify that all meters have been pre-operationally inspected per SPL-SOP-8.10.2, *Radiation Monitoring Instrumentation*.

5.3.2 Establish instrument background in an appropriate area and MDA for each meter. Material chosen as background reference material will be similar in chemical, physical and radiological characteristics and will also be non-radiologically impacted from site operations.

5.3.3 Record data on the appropriate survey forms in accordance with CMS-710-07-WI-40111, *Performing and Documenting Radiation and Contamination Surveys*. Instruments used in surveys must be capable of achieving an MDA that is less than the applicable release limits.

5.3.4 Scans of the items may use the following (or equivalent of):

- Ludlum 43-93 Alpha/Beta Scintillator coupled with a Ludlum 2360
- Ludlum 43-68 Gas Proportional Detector coupled with a Ludlum 2360
- Ludlum 19, Exposure Rate Meter

D2005-0008-001
Material and Equipment Release Surveys

CMS Number:	Revision:	Approval Date:
N/A	0	

5.3.5 While Surveying:

- Use the scan speed of 1.25 cm/s for alpha/beta surveys.
- Obtain static measurements at locations showing the highest count rate during the scan.
- Locations will be determined by the RCT in accordance with PRSO or RCS guidance. The typical count time for the static measurement is one minute.
- Identify and mark any items that exceed investigational levels.
- Record data on the appropriate survey forms (See CMS-710-07-FM-40111, *Radiological Survey Forms*).
- Segregate potentially contaminated items from non-contaminated items, if necessary.

5.4 Direct Probe Surveys for Total Contamination

5.4.1 Direct probe surveys are used to determine total contamination levels. Direct probe surveys may be used in concert with swipe surveys to complete a contamination survey. Direct probe surveys may be used to demonstrate that total contamination levels are less than the removable contamination release criteria. (In this case swipes may not be required, as determined by the PRSO). Total contamination readings should be taken prior to swiping the surveyed surface.

5.4.2 Obtain proper instrumentation for the survey type. Ensure that the instruments are currently calibrated (i.e. calibration sticker attached to meter) and have satisfactorily completed a function check in accordance with SOP-SPL-8.10.2 prior to use.

5.4.3 Obtain a survey map of the item to be surveyed. The completed map should indicate where survey readings are to be taken. .

5.4.4 Take a background reading in the same area as the survey. Record the area background on the survey form.

5.4.5 Scan the item (as appropriate for the item classification). Take a direct stationary reading at each survey location and record the cpm value. Typically one stationary reading will be taken per survey location. This reading will be corrected to a 100 cm2 area reading by the probe Area Correction Factor (ACF).

5.5 Swipe Surveys for Removable Contamination

5.5.1 Swipes are not necessary if direct probe readings demonstrate that the total contamination levels are below the removable contamination levels.

5.5.2 If required, obtain swipes, envelopes, and a survey map of the item to be surveyed. Swipe each designated location.

5.5.3 Each survey location should be pre-identified (written) on the swipe backing paper, or as the swipe is taken. Close the swipe backing paper and place the swipes together in the envelope. The envelope should be labeled with the area, date, and technician. Additional information may be placed on the envelope, or on the swipe backing.

5.5.4 Transport the swipes to the counting facility.

5.6 Instrument Data Quality

5.6.1 At the end of the shift the instruments will be given a post operational check consisting of the steps used in the preoperational check, per SOP-SPL-8.10.2. The results will be recorded on the appropriate forms.

5.6.2 The PRSO or RCS shall review all survey data prior to the release of any items. Upon PRSO or RCS approval, RCTs will perform material and equipment release actions.

D2005-0008-001
Material and Equipment Release Surveys

CMS Number:	Revision:	Approval Date:
N/A	0	

5.7 Records

Copies of the records generated by this work instruction are maintained on site for the duration of project activities. Original records are periodically transmitted to the CB&I Federal Services LLC Concord, CA office for storage in the central file system.

6.0 ATTACHMENT

U.S. Atomic Energy Commission, Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, Table 1 – Acceptable Surface Contamination Levels

Radionuclide[a]	Disintegrations/minute/100-square-centimeters (dpm/100 cm^2)		
	Average[b c f]	Maximum[b d f]	Removable[b e]
U-nat, ^{235}U, ^{238}U & associated decay products	5,000 (α)	15,000 (α)	1,000 (α)
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100	200	20
Th-nat, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000	3,000	200
β-γ emitters (nuclides with decay modes other than α-emissions of SF) except ^{90}Sr and others noted above.	5,000 (β-γ)	15,000 (β-γ)	1,000 (β-γ)

Notes:

U.S. Atomic Energy Commission, 1974, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, Washington D.C.

[a]*Where surface contamination by both α- and β-γ-emitting nuclides exists, the limits established for α- and β-γ-emitting nuclides should apply independently. [The values apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item.]*

[b]*As used in this table, dpm means the rate of emission by radioactive material as determined by correcting the counts per minute observed by the appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.*

[c]*Measurements of average contamination should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.*

[d]*The maximum contamination level applies to an area of not more than 100 cm^2*

[e]*The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent material, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. [The use of dry material may not be appropriate for tritium.] When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire area should be wiped. [Except for transuranics and ^{226}Ra, ^{227}Ac, ^{230}Th, ^{228}Th, ^{231}Pa, and α-emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination (i.e., removable and fixed) are within the limits for removable contamination.]*

[f]*The average and maximum radiation levels associated with surface contamination resulting from β-γ-emitting nuclides should not exceed 0.2 mrad/hr @ 1 cm and 1.0 mrad/hr @ 1 cm, respectively, measured through 7 milligrams per square centimeter (mg/cm^2) of total absorber.]*

Note: Comments in brackets [ ] have been added by CB&I.

WORK INSTRUCTION

Work Instruction Title:	**D2005-0008-003 – Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation**	**CMS Number:**	**N/A**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**N/A**

D2005-0008-003
SCREENING OF TRUCKS USING STATIONARY PORTAL MONITOR AND PORTABLE SURVEY INSTRUMENTATION

2	Revision to alarm setpoint based on firmware update (5.1.9) and addition of Attachment 3	JRH	8/15/16
1	Revisions to 5.1.4.1, 5.1.4.2, and addition of alarm setpoint (5.1.9)	JRH	7/11/16
0	Initial submittal.	JRH	2/2/16
Rev	**Changes**	**Approved**	**Date**

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D2005-0008-003
Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation

CMS Number:	Revision:	Approval Date:
N/A	2	8/15/16

1.0 PURPOSE

The purpose of this procedure is to provide guidelines for performing gamma radiation screening of trucks loaded with non-contaminated soils and debris leaving the site using a Ludlum Model 3500-1000 portal monitor or equivalent. The purpose of the portal scan is to protect against the inadvertent shipment of materials exhibiting elevated radiation levels. The survey described in this work instruction serves only to release the contents of the truck and not the truck itself. This procedure also addresses alternate hand screening of trucks using portable survey instruments in the event the portal monitor is inoperative or additional measurements are required.

2.0 APPLICATION

This procedure describes the appropriate methods for using the portal monitor and portable survey instruments to perform gamma radiation screening of trucks loaded with non-radioactive soils and debris that will be transported to recycling centers, landfills, or other disposal facilities.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

3.1 The following personnel have responsibilities in this WI:

- Project Radiation Safety Officer (PRSO)/Alternate PRSO
- Radiological Control Supervisor (RCS)
- Lead Radiological Control Technician
- Radiological Control Technician

3.2 Responsibilities

3.2.1 The PRSO is responsible for the maintenance, management, and revision of this work instruction. The PRSO is also responsible for ensuring workers comply with the requirements of this WI. The PRSO will be required to notify CB&I Project Management and an appropriate client representative whenever a truck or its load triggers an alarm using the portal monitor and/or fails surveys conducted by alternate methods. The PRSO provides training on use of the portal monitor system and alternate hand screening methods. Prior to allowing material/waste to leave HPNS property for off-site release or disposal as non-radiological waste, the PRSO will confirm with appropriate client representatives and contractors that appropriate documentation to verify the origin and radiological characteristics of the material is present.

3.2.2 The RCS is responsible for the field oversight of the radiological control technician (RCT) performing tasks detailed in this WI. The RCS notifies the PRSO immediately whenever a truck or its load triggers an alarm using the portal monitor and/or fails surveys conducted by alternate methods.

3.2.3 The lead RCT may be assigned responsibility by the PRSO or RCS for the field oversight at a specific work site of RCTs performing tasks detailed in this WI.

3.2.4 The RCT is responsible for compliance with this work instruction and for addressing any issues or suggested modifications with the RCS or PRSO. The RCT performs truck surveys using the portal monitor, and performs alternate hand-held surveys in accordance with this work instruction. The RCT is also responsible for notifying the RCS or PRSO if the portal monitor is inoperable, and whenever a truck or its load triggers an alarm using the portal monitor and/or fails surveys conducted by alternate methods.

D2005-0008-003
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CMS Number:	Revision:	Approval Date:
N/A	2	8/15/16

4.0 REFERENCES

CFR, Title 10, Part 20, Standards for Protection against Radiation, U.S. Government Printing Office, Washington, D.C., January 1, 2011, available online at 10CFR20 (current version).

CMS-710-07-PR-04000, *Radiation Safety Program*

CMS-710-07-PR-04005, *Radiation Safety Training*

CMS-710-07-PR-04011, *Radiological Surveys and Monitoring*

CMS-710-07-PR-04013, *Radiation Detection Instrumentation*

CMS-710-07-WI-04008, *Radiological Work Permits*

CMS-710-07-WI-40111, *Performing and Documenting Radiation and Contamination Surveys*

CMS-710-07-FM-40111, *Radiological Survey Forms,* example

SPL-SOP-8.10.2*, Radiation Monitoring Instrumentation*

U.S. Atomic Energy Commission, Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, Table 1.

5.0 WORK INSTRUCTION

5.1 Prerequisites

5.1.1 Staff performing this procedure must be trained and qualified per CMS-710-07-PR-04005, Radiation Safety Training.

5.1.2 In collaboration with the PRSO, RCS or lead RCT, choose an appropriate and safe location for placement of the stationary portal monitor system, and locations for portable instrument surveys.

5.1.3 Gather appropriate information and supplies, such as the following:

5.1.3.1 Historical survey data, recent survey information, if available, and any other information that would be useful to perform a proper survey.

5.1.3.2 General survey report form (or equivalent), truck survey tracking log, map of the area to be surveyed, gloves, appropriate smears and instruments, plastic bags and labels (as needed), and a marker or pen.

5.1.4 Prior to removing any material:

5.1.4.1 The PRSO or RCS will confirm that appropriate documentation has been approved by the shipping contractor's client representative stating the materials to be removed have been cleared for disposal as non-radiological waste.

5.1.4.2 For materials being shipped from areas under radiological controls, the PRSO, RCS or their designee will coordinate with the shipping contractor to ensure that materials being loaded are indeed those materials approved by that contractor's client representative.

5.1.5 Required personal protective equipment must be in accordance with the RPP, RWP (if required), and Job Safety Analysis document covering the specific work or area.

5.1.6 Check instruments for operability, such as battery check and high voltage check. Verify that the instrument calibration is current.

5.1.7 Review and sign applicable RWP(s) for the specific work area, task, or job.

D2005-0008-003
Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation

CMS Number:	Revision:	Approval Date:
N/A	2	8/15/16

5.1.8 Comply with general industrial safety standards, including those found in the Job Safety Analysis while conducting surveys. For example, never place your body in harm's way when performing surveys on suspended loads. Use long handled meters to reach under the load. Never place your body beneath suspended loads exceeding 50 pounds. Do not perform surveys near exposed wiring, pressurized lines, cryogen lines, or dewars, unless they have been proven to be safely de-energized per CMS-710-02-PR-01500, Control of Hazardous Energy.

5.1.9 Using firmware version 38407n46 or higher, the detector alarm set point will be set to 2 uR/hr above background with the concurrence of the Navy Radiological Affairs Support Office (RASO). Using the calculation in Attachment 3, 2 uR/hr above background is equivalent to 15 standard deviations above background.

5.1.10 Truck drivers must be aware of the survey procedure and adhere to the driving speed requirements noted in Section 5.2 when passing through the detectors. Failure to carefully follow these requirements may result in invalid or incomplete screenings and will result in the screening having to be repeated.

5.2 Limitations

5.2.1 The following limitations apply to this WI.

5.2.1.1 Calibration shall be performed annually, after maintenance is performed or if the instrument fails the performance test or if proper operation is in question. Calibration is to be conducted by the manufacturer per the manufacturer's instruction manual.

5.2.1.2 Setup and daily performance tests will be conducted in accordance with the operating manual for the Ludlum Model 3500-1000 portal monitor. One performance test is required per each day of instrument use.

5.3 Portal Monitor Operation

5.3.1 When using the Ludlum Model 3500-1000 for gamma screening surveys of trucks loaded with soil and/or debris, an RCT trained in the operation of the Model 3500-1000 will be present to operate the instrument. The RCT's training on the portal monitor must be officially documented, with training records verified by the PRSO or RCS before assigning an individual to operate the system.

5.3.2 The following steps are to be used during operation of the portal monitor system. Please note that the system continuously monitors radiation when the portal is occupied and compares the readings to the alarm level determined by using an average of the background levels. If the alarm threshold is breached, the audible and visual alarms will be activated.

Step	Action
1	Verify that all cables and power are connected, and turn the instrument to the "on" position.
2	Ensure that the green lights on the "Power OK" and "System OK" are illuminated. If both lights are not illuminated, contact the PRSO or RCS.
3	Record the date, time, type of material, material location (origin of material) and license plate of the vehicle on the Truck Survey Log (Attachment 1).
4	Have the truck advance toward the detector slowly until the occupancy sensor is tripped.
5	Inform the truck driver to proceed slowly through the detectors. The rate of travel should be as slow as possible (not to exceed 3 miles per hour). If the truck is traveling too fast, a red over-speed light will illuminate on the instrument panel.
6	If the over-speed light illuminates, request that the truck driver proceed forward and turn

D2005-0008-003
Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation

CMS Number:	Revision:	Approval Date:
N/A	2	8/15/16

Step	Action
	around to restart the screening process. Wait for the instrument to be manually reset before proceeding.
7	While the truck is passing through the detectors, a green “checking” light will illuminate to tell the operator that the infrared motion detectors are operating properly. When the truck completes its pass (indicated by the checking light going off), it is necessary for the driver to pause the truck until cleared by the RCT to proceed or to return for a rescreen. If the checking light repeatedly does not illuminate while a truck is passing through, have the truck stop in a convenient location nearby. Notify the RSOR that the unit is not operational. At this point, the load contents have not been released and the portal monitor will have to be repaired and the truck re-scanned or a hand survey conducted. If a hand survey is to be used, proceed to Step 1 of Section 5.4 below.
8	If the checking light illuminates and the red alarm light does not illuminate when the truck has completed a pass, record the results (clean) under the Pass 1 column on Attachment 1 and proceed to Step 14. In the event that the red alarm light illuminates, let the truck continue through the detectors and record results (alarm) under the Pass 1 column on Attachment 1 and proceed to Step 9.
9	Inform the truck driver that it will be necessary to pass through the detectors again to confirm the alarm. Direct the truck driver to reposition the truck for another pass through the detector.
10	Push the reset button (if necessary). If the checking light illuminates and the red alarm light illuminates, let the truck continue through the detectors, record the results (alarm) under the Pass 2 column on Attachment 1, and proceed to Step 13. In the event that the red alarm light does not illuminate, let the truck continue through the detectors, record the results (clean) under the Pass 2 column on Attachment 1, and proceed to Step 11.
11	Inform the truck driver that it will be necessary to pass through the detectors again to confirm the portal monitor did not alarm. Direct the truck driver to reposition the truck for another pass through the detector.
12	Push the reset button (if necessary). If the checking light illuminates and the red alarm light does not illuminate when the truck passes through, record the results (clean) under the Pass 3 column on Attachment 1, and proceed to Step 14. In the event that the red alarm light illuminates, let the truck continue through the detectors, record the results (alarm) under the Pass 3 column on Attachment 1, and proceed to Step 13.
13	Inform the truck driver that the load is not releasable and follow the steps in Section 5.5 below. Indicate “Ret.” under the Disposition header of the Truck Survey Log to indicate the load has been returned, and initial the appropriate line on the Truck Survey Log. Have the truck driver initial the log as well. Subsequent truck surveys can now be conducted beginning at Step 1 above.
14	The truck load can be released. Indicate “Rel.” under the Disposition heading on the Truck Survey Log and initial next to the appropriate row. Have the truck driver initial the log as well. Subsequent truck surveys can now be conducted beginning at Step 1 above.

D2005-0008-003
Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation

CMS Number:	Revision:	Approval Date:
N/A	2	8/15/16

5.4 Hand Screening of Trucks

5.4.1 In instances where the portal monitor malfunctions while a truck is being surveyed, or if the portal monitor is inoperable, or if a truck fails two out of three passes, a hand survey will be required.

5.4.2 Hand-held gamma instruments (such as Ludlum Model 193-6 plastic scintillation detector, Ludlum Model 2221 with Ludlum Model 44-10 2-inch by 2-inch sodium iodide (NaI) detector, or other appropriate gamma radiation detector) are used to survey trucks. The survey instruments are set up in accordance with the requirements of CMS-710-07-PR-04013, *Radiation Detection Instrumentation* and SPL-SOP-8.10.2, *Radiation Monitoring Instrumentation*, and performed in accordance with CMS-710-07-PR-04011, *Radiological Surveys and Monitoring*; CMS-710-07-WI-40111, *Performing and Documenting Radiation and Contamination Surveys*; and other applicable requirements.

5.4.3 Surveys should be performed in an area that is convenient to the workplace traffic flow. The area should be sufficiently isolated from any potential sources of radiation, and should allow the technician to obtain easy access to all sides of the vehicle. It is anticipated that when hand surveys are necessary, they will be conducted adjacent to the location where the portal monitor has been installed; however, an alternative location may be used.

5.4.4 The following steps will be performed when performing a hand survey:

Step	Action
1	In an area adjacent to where the trucks are being screened and known to be free of radioactive material, establish a background count rate and record it on the Radiological Truck Survey Form for Portable Instruments (Attachment 2). If multiple surveys are to be performed in a single area, then the background only needs to be established once for that area.
2	The end of the detector should be held approximately 4 inches from the surface of the truck containing the load when performing surveys.
3	Move the detector over the surface of the truck or containers in a serpentine pattern at a rate of < 0.5 meter per second covering 100 percent of the surface of the sides, the undercarriage, and the rear portion of the truck where the load is contained. Extra scrutiny should be used for any areas that result in significant increase in the audible signal of the meter. For maximum readings, as specified on Attachment 2, the technician performing the survey will use experience and judgment to take a meter level reading at the point of greatest audio response for the given side/area being surveyed.
4	When taking a reading for a maximum count rate on a given side/area, read the meter after sufficient response time has elapsed (i.e., the meter needle is relatively stable and the audible count rate is relatively stable) typically 8–10 seconds at near background count rates.
5	If the hand screening survey results in readings greater than 2 uR/hr above background using the Ludlum Model 193-6, or above a predetermined background gamma rate determined in consultation with RASO using the Ludlum 44-10, the PRSO and RCS will be notified immediately. Upon confirmation that the measurement exceeds the criterion for release, the appropriate client representative will be notified. Document the survey results on the appropriate survey form (Attachment 2). Inform the truck driver that the load is not releasable, and follow the steps in Section 5.4 below.
6	If the hand screening survey results are below 2 uR/hr above background using the Ludlum Model 193-6, or 10,000 cpm using the Ludlum 44-10 (or otherwise determined in conjunction with RASO based on the typical background gamma rates for that area), the truck may be released.

D2005-0008-003
Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation

CMS Number:	Revision:	Approval Date:
N/A	2	8/15/16

5.5 Protocol for Trucks Failing to Receive Portal Monitor or Hand Survey Clearance

5.5.1 When a truck causes two or three portal monitor alarms to trigger in three passes, or fails a hand screening using portable survey instrumentation, the truck will not be released off site. The PRSO shall be contacted immediately and apprised of the situation. The PRSO and/or PM will also contact RASO and the Navy Remedial Project Manager (RPM) and brief them of the situation.

5.5.2 The following steps shall be taken in response to a truckload that does not receive portal monitor clearance:

Step	Action
1	Copies of the portal monitor output for all passes resulting in an alarm shall be retained by the operators for inclusion with the truck survey log.
2	The offending truck, with load in place, shall initially be subjected to a hand survey per the procedures in Section 5.4. If a hand survey has already been completed and documented per the procedures in Section 5.4, proceed to step 4 below.
3	A hand survey log shall be completed and also appended to the truck survey log. The purpose of the hand survey is to identify whether elevated areas of radiation exist that may indicate the presence of radioactive material. Particular attention should be given to the area of the truck that caused the alarm according the portal monitor (e.g., alarm in back). NOTE: If an area of elevated activity is not identified using a follow-up hand survey, immediate notification should be given to the PRSO, who will inform the PM, who will inform the both RASO and the Navy RPM.
4	If the contractor from which the failed load originated is a licensed contractor working under the HPNS memorandum of understanding, the failed load will be escorted by an RCT or and RCS to that contractor's radiologically controlled work area. If the originator is not working under a radioactive materials license, the truck will be temporarily staged in a CB&I controlled area.
5	For trucks returned to the CB&I controlled area, the truckload is dumped for further characterization and survey activities. Material should be placed on a plastic liner or other surface to prevent the spread of potential contamination. Rejected truckload piles must be kept segregated until the pile has been surveyed, sampled, and the results have been reviewed by the PRSO, and with concurrence from the appropriate client representative.
6	After the materials are offloaded, trucks shall be scanned upon exiting the impacted area, and the empty truck will be re-run through the portal monitor. If the truck does not alarm the portal monitor, it is free to return to service. If the empty truck alarms the portal monitor, the PRSO and RCS shall be notified and all portal monitor operations shall be temporarily halted pending resolution by the PRSO, and concurrence from RASO and the Navy RPM. NOTE: Trucks that have dumped material in radiologically controlled work areas due to elevated measurements obtained during portal monitor or portable instrument surveys may require survey and decontamination of the truck, including the bed and tires based on applicable contractor radiological controls. Specific truck decontamination procedures will be determined in consultation with RASO and the Navy RPM.
7	For trucks returned to CB&I controlled areas, CB&I will conduct gamma scanning surveys of the soil using established procedures for radiological screening yard pads. The scans and any subsequent sampling will be dependent on the area from which the soil originated. The pile shall be spread into a ≤ 6-inch laydown area and a hand survey shall be conducted. Any sources located during the rescan of a rejected truckload pile require that notification be given to the RCS, who will notify the PRSO. Upon

Step	Action
	confirmation of the nature of the radioactive source, the PRSO will notify RASO and the Navy RPM. The disposition of the pile will be determined by the RCS or designee with concurrence from the appropriate client representative. If no sources are found during the gamma scanning survey, a minimum of two samples shall be taken from the pile and sent for analysis for the potential radionuclides of concern. Samples will be collected at areas exhibiting radiation levels equal to or greater than 3 sigma plus mean background (or other radiation level, as agreed upon by the client representative). If radiation measurements do not exceed 3 sigma plus background (or other radiation level, as agreed upon by the client representative), the samples will be selected from two areas exhibiting the highest gamma scan measurements. All areas exhibiting a gamma radiation count rate exceeding a predetermined background gamma rate determined in consultation with RASO using a Ludlum 44-10 will be sampled.
8	If the sample results do not indicate the presence of any of the radionuclides of concern above the release limits, then the stockpile can be either reloaded into a truck and run through the portal monitor again, or aggregated with an existing clean stockpile. If the sample results indicate the presence of one or more radionuclides above the release criteria, the entire load shall be placed into a waste bin for further characterization and off-site disposal.

5.6 Records

When following this work instruction, a Truck Survey Log, provided as Attachment 1, will be generated and retained in the permanent project file. Multiple entries can be made on the same survey form for trucks that do not set off the alarm on the detector. If a hand survey is performed, a separate survey form (Attachment 2) will be used.

The RCS will attach a copy of the documentation authorizing clearance of the material to the Truck Survey Log.

Copies of the records generated by this work instruction are maintained on site for the duration of project activities. Original records are periodically transmitted to the CB&I Federal Services LLC Concord, CA office for storage in the central file system.

6.0 ATTACHMENTS

Attachment 1, Truck Survey Log

Attachment 2, Radiological Truck Survey Form for Portable Instruments

Attachment 3, Ludlum Measurements, Inc., Pennsylvania Firmware Versions (38407N46 and above) Ludlum Model 3500-1000, February, 2004, and CB&I Calculations (August 2016)

D2005-0008-003
Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation

CMS Number:	Revision:	Approval Date:
N/A	2	8/15/16

ATTACHMENT 1
TRUCK SURVEY LOG

Date	Time	Note	Type of Material	Material Location	License Plate No.	Pass 1		Pass 2[a]		Pass 3[b]		Hand Survey[c]		Disposition[d]		Technician Initials	Driver Initials
						Alarm	Clean	Alarm	Clean	Alarm	Clean	Req'd.	Comp.	Rel.	Ret.		

[a] Pass 2 and 3 are not necessary if Pass 1 is clean
[b] Pass 3 is not necessary if Pass 1 and Pass 2 both alarm
[c] Indicate of hand survey is required; if so, initial upon completion
[d] Indicate load release or return.
Notes: 1 = Alarm 2 = Heavy Load 3 = Light Load 4 = Empty

D2005-0008-003
Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation

CMS Number:	Revision:	Approval Date:
N/A	2	8/15/16

Attachment 2
Radiological Truck Survey Form for Portable Instruments

Date:	Time:	Truck Identification (license plate/ID):
Purpose of Survey: (include load origin)		

Instruments Used			
Model Number	Serial Number	Calibration Due Date	Background/Units
1.			
2.			
3.			

Item or Location	Gross Measurement/Units	Distance or Location from Surface of the Vehicle
1. Max Reading on Sides of Vehicle		4"
2. Max Reading on Underside of Vehicle		4"
3. Max Reading on Rear of Vehicle		4"
4.		
5.		
6.		
7.		
Sketch/Diagram (optional):		
Remarks:		
Disposition (Released/Returned):		

Surveyor (initials):	Reviewed by: (signature)	Date:

LUDLUM MEASUREMENTS,INC.
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SWEETWATER, TX 79556, U.S.A
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DESIGNER AND MANUFACTURER OF
Scientific and Industrial Instruments

Pennsylvania Firmware Versions (38407N46 and above) Ludlum Model 3500-1000 February, 2004

To meet the radiation detection requirements of the state of Pennsylvania, Ludlum Measurements has created a special version of firmware (38407N46) for use in the Model 3500-1000. This version of firmware has an expanded alarm-setting range (5-80 sigma), individual detector alarms, a 10 mph overspeed alarm, and an alarmpoint calculation that only uses ambient background as the baseline to calculate the alarmpoint.

Alarmpoint Table-internal 16 position switch settings:

Setting	Number of Sigma/Deviations above ambient background
0	5
1	10
2	15
3	20
4	25
5	30
6	35
7	40
8	45
9	50
A	55
B	60
C	65
D	70
E	75
F	80

Onsite Alarmpoint Calculation:

Since the radiation background varies by geographic region, the alarmpoint setting must be reset onsite. Use the following procedure to calculate the setting:

1) Measure the background microR/hr reading at the system location and compare to the kcps (kilo counts per second) analog reading of the Model 3500 to get a conversion of cps per microR/hr.
A typical value of background as measured by a calibrated microR/hr meter (Ludlum Model 19, Model 192, or equivalent) is a value between about 5 and 15 microR/hr. A typical kcps reading on the Model 3500 is 2 kcps (or 2000 cps).

Example: A microR/hr meter measures 12 microR/hr on-site, and the Model 3500 measures 3 kcps. The conversion is then 3kcps / 12microR/hr or 0.25 kcps (or 250 cps) per microR/hr.

2. Calculate the 1.5 second equivalence of background and 10 microR/hr.

Since the alarm is calculated on a 1.5 second basis, both the background and the desired alarmpoint must be adjusted in terms of counts.

Example: Background is shown on the Model 3500 meter as 3kcps, so 1.5 seconds of background is equal to 4500 counts. Ten (10) microR/hr is equal to 2500 cps (using the conversion calculated in step 1) above, or 3750 counts in 1.5 seconds.

3. Calculate the sigma setting for 10 microR above background
Sigma equals the alarm value in 1.5 seconds divided by the square root of background in the same 1.5 second interval.

Example: Sigma is calculated by dividing 3750 counts by the square root of 4500. The value is 3750/67, or 56 sigma.

4. Select the unit sigma setting nearest to but not greater than the calculation above.
The unit settings are from 0 to 9 then A through F. This is a total of 16 settings in 5 sigma intervals. For example, 0 = 5 sigma, 1 = 10 sigma, 2 = 15 sigma,…,A = 55 sigma, B = 60 sigma,…,E = 75 sigma, F = 80 sigma.

Example: The amount calculated above was 56 sigma, the closest point on the switch would be a setting of A= 55 sigma.

5. Adjust the sigma to allow for higher truck speeds.
The sensitivity of the detector is lowered as speed increases. The sigma value must be lowered to compensate. The sigma setting is proportional to the square root of the ratio of the change of speed. The calculation above is appropriate for 6 mph. To account for speeds up to 10 mph, the change is a ratio increase of 1.6. The square root of this value is 1.26. The sigma value should be lowered by factor of 1.26.

Example: Sigma was calculated to be 68, so it is reduced to a new value calculated as 56/1.26 or 44 sigma. The setting of “7” should be selected, which is 40 sigma above background .

6. Verification using supplied 10 microcurie check source.
Ludlum Measurements supplies an exempt 10 microcurie checksource that may be used to verify and check for proper operation. This verification can be done as a one-time process, or as a regular check to ensure system operation. The checksource is only accurate to within 20% so some allowances must be made for uncertainty. The 10 microR/hr limit as specified by the state of Pennsylvania is equal to a distance of approximately 22.5 inches between the source and the internal face of the detector. One could pass the checksource within 17.5 inches, equal to 12 microR/hr, of the front of the detector’s housing (while blocking the infrared beam) to confirm that the system alarms.

To confirm that the alarm isn’t too sensitive, one could also pass the checksource 29 inches in front of the detector housing, equal to 5 microR/hr above background, and verify that the system does not alarm.

CB&I HPNS - Portal Monitor Alarm Set Point Calculation - August 2016

Background Count Rate		
1.2	1.4	kcps

Step 1 - Determine count rate to exposure rate ratio
Observed background - Model 19

5-6	uR/hr
5.5	uR/hr - average
236.4	cps/uR/hr
0.236	kcps/uR/hr - observed

Step 2 - Calculate 1.5 second equivalence of background and 2 uR/hr

1300	average counts per second
1950	counts in 1.5 seconds
2	uR/hr
0.473	kcps
472.7	counts in one second
709.1	counts in 1.5 seconds

Step 3- Calculate sigma setting for 3 uR/hr above background
Equal to alarm value in 1.5 second divided by sq root of background value in 1.5 seconds
16.1

Step 4 - Select sigma setting
Closest setting is 15 SD

Step 5 - Adjust the sigma to allow for faster truck speeds
Not applicable - truck speeds will be maintained at or below 3 mph.

Step 6 - Verification using supplied 10 microcurie check source

Per Ludlum instructions:

10 uR/hr	22.5 inches
12 uR/hr	17.5 inches
5 uR/hr	29 inches

Using inverse square law:

2 uR/hr	50.31	using 10 uR/hr distance
2 uR/hr	42.87	using 12 uR/hr distance
2 uR/hr	45.85	using 5 uR/hr distance

10 uCi Cs-137 source tested to alarm at 44 inches from each detector - 8/15/16

Step 1 - Determine count rate to exposure rate ratio
0.293 kcps/uR/hr per Ludlum email dated 7/22/16

Step 2 - Calculate 1.5 second equivalence of background and 2 uR/hr

1300	average counts per second
1950	counts in 1.5 seconds
2	uR/hr
0.586	kcps
586.0	counts in one second
879.0	counts in 1.5 seconds

Step 3- Calculate sigma setting for 3 uR/hr above background
Equal to alarm value in 1.5 second divided by sq root of background value in 1.5 seconds
19.9

Step 4 - Select sigma setting
Closest setting is 20 SD

WORK INSTRUCTION

Work Instruction Title:	**D2005-0008-004 – Operation and Use of Portable Instruments at Hunters Point Naval Shipyard**	**CMS Number:**	**N/A**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**N/A**

D2005-0008-004
OPERATION AND USE OF PORTABLE INSTRUMENTS AT HUNTERS POINT NAVAL SHIPYARD

0	Initial submittal.	JRH	6/27/16
Rev	**Changes**	**Approved**	**Date**

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D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

1.0 PURPOSE

This project-specific work instruction (WI) provides specific direction for the use of portable radiological instruments at Hunters Point Naval Shipyard (HPNS) and demonstrates the suitability of the selected instruments to adequately detect the primary radionuclides of concern, radium 226 (^{226}Ra), cesium-137 (^{137}Cs), and strontium-90 (^{90}Sr). The survey instruments and techniques documented herein will also be used for other potential radionuclides at HPNS, including, but not limited to, plutonium-239 (^{239}Pu) and cobalt-60 (^{60}Co).

2.0 APPLICATION

This WI provides standard practices and operating procedures for the instruments listed in Table 1 and equivalent instruments. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when operating these instruments. Proper control, calibration, and daily checks of these instruments ensure that operating parameters demonstrate compliance with applicable data quality requirements and/or regulations. Also provided in this WI are instructions for the documentation of instrument performance and survey data. Use of these detectors is for performance of surveys to identify potential radionuclides of concern in the environment, on materials, or on equipment in excess of instrument specific investigation levels or project release criteria.

Table 1. Portable Instruments

DETECTORS	DETECTOR TYPE	TYPICAL METERS		USE
Ludlum 43-68	126 cm^2 Gas-flow proportional	Ludlum 2360	Ludlum 2224	Alpha/beta surface contamination surveys
Ludlum 43-93	100 cm^2 ZnS scintillator	Ludlum 2360	Ludlum 2224	Alpha/beta surface contamination surveys
Ludlum 43-37	584 cm^2 Gas-flow proportional	Ludlum 2360	Ludlum 2224	Alpha/beta surface contamination surveys
Ludlum 44-10	2-in x 2-in NaI scintillator	Ludlum 2221	Ludlum 2350-1	Gamma investigation surveys
Ludlum 44-20	3-in x 3- in NaI scintillator	Ludlum 2221	Ludlum 2350-1	Gamma investigation surveys
Ludlum 43-10-1	ZnS adhered to plastic scintillator	Ludlum 2929	NA	Alpha/beta sample counting
Integral internal detector	ZnS adhered to plastic scintillator	Ludlum 3030	NA	Alpha/beta sample counting
Integral internal detector	Ion Chamber	Ludlum 9-3	NA	Beta/gamma exposure rate surveys; mR/hr
Integral internal detector	1-in x 1-in NaI scintillator	Ludlum 19	NA	Gamma exposure rate surveys; µR/hr

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

3.1 The following personnel have responsibilities in this WI:

- Project Radiation Safety Officer (PRSO)/Alternate PRSO
- Radiological Control Supervisor (RCS)
- Lead Radiological Control Technician
- Radiological Control Technician

3.2 Responsibilities

3.2.1 The Project Radiation Safety Officer (PRSO) is responsible for the maintenance and management of the instrumentation. The PRSO is also responsible for making sure Radiological Control Technicians (RCTs) are following this procedure as described herein.

3.2.2 The Radiological Controls Supervisor (RCS) is responsible for the oversight of the RCTs operating these instruments. The lead RCT may be assigned responsibility by the PRSO or RCS for the field oversight at a specific work site of RCTs performing tasks detailed in this WI.

3.2.3 The Radiological Control Technicians (RCT) are responsible for compliance with this WI, recognizing instrumentation problems and notifying the RCS or PRSO of malfunctioning instruments. RCTs shall understand project investigation levels and release criteria and know how to compare instrument response to the applicable investigation levels or release criteria.

4.0 REFERENCES

CFR, Title 10, Part 20, Standards for Protection against Radiation, U.S. Government Printing Office, Washington, D.C., January 1, 2011, available online at 10CFR20 (current version).

CMS-710-07-PR-04000, *Radiation Safety Program*

CMS-710-07-WI-04005, *Radiation Safety Training*

CMS-710-07-WI-04009, *Radiological Work Permits*

CMS-710-07-WI-04012, *Radiological Surveys and Monitoring*

CMS-710-07-WI-40121, *Performing and Documenting Radiation and Contamination Surveys*

CMS-710-07-FM-40121, *Radiological Survey Forms,* example

CMS-710-07-WI-04014, *Radiation Detection Instrumentation*

Grove Engineering, Inc., *Microshield,* current version or equivalent

SPL-SOP-8.10.2*, Radiation Monitoring Instrumentation*

U.S. Atomic Energy Commission, Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, Table 1.

U.S. Department of Defense, U.S. Department of Energy, U.S. Nuclear Regulatory Commission, and U.S. Environmental Protection Agency, 2000, *Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG 1575, Revision 1, August.

U.S. Nuclear Regulatory Commission, 2016, Code of Federal Regulations, 10 CFR 20, Standards for Protection Against Radiation.

U.S. Nuclear Regulatory Commission, NUREG-1757, Vol. 2, Rev. 1 “Consolidated Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria”

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

U.S. Nuclear Regulatory Commission, NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions"

5.0 WORK INSTRUCTION

5.1 Prerequisites

5.1.1 Staff performing this procedure must be trained and qualified per CMS-710-07-WI-04005, Radiation Safety Training.

5.1.2 In collaboration with the PRSO, RCS or lead RCT, choose an appropriate and safe location for performance of instrument setups and daily function checks.

5.1.3 Review and sign applicable RWP(s) for the specific work area, task, or job.

5.1.4 Comply with general industrial safety standards and the project Accident Prevention Plan.

5.2 Limitations

5.2.1 The following limitations apply to this WI.

5.2.1.1 Calibration shall be performed annually, after maintenance is performed or if the instrument fails the performance test or if proper operation is in question. Calibration is to be conducted by the manufacturer per the manufacturer's instruction manual.

5.2.1.2 Table 2 compares the energies of the check sources in use to the project radionuclides of concern and demonstrates that instrument specific responses based on these check sources will result in satisfactory detection of radionuclide of concern activity.

Table 2. Source Energy Comparison

RADIONUCLIDE	ALPHA ENERGY (MeV)	BETA MAX ENERGY (MeV)	GAMMA ENERGY (MeV)
Radionuclides of Concern			
^{226}Ra	4.78 (95% abun)	^{214}Bi, 1.5 (40% abun) ^{214}Pb, 0.65 (40% abun)	^{226}Ra, 0.18 (4% abun) ^{214}Bi, 0.69 (47% abun) ^{214}Pb, 0.35 (36% abun)
^{137}Cs	N/A	^{137}Cs, 0.51	^{137}Cs, 0.662 (85% abun)
^{90}Sr	N/A	^{90}Sr, 0.546 (100% abun) ^{90}Y, 2.28 (99.99% abun)	N/A
^{239}Pu	5.16 (73% abun) 5.14 (15% abun) 5.11 (11.5% abun)	N/A	0.0136 (4.4% abun)
^{60}Co	N/A	0.318 (100% abun)	1.173 (100% abun) 1.333 (100% abun)
Project Check Sources			
^{230}Th[1,2,5]	4.68 (76% abun)		
^{99}Tc[1,3]		^{99}Tc, 0.29	
^{137}Cs[1,4, 6]		^{137}Cs, 0.51	^{137}Cs, 0.662 (85% abun)

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

[1] The check sources in use include one of these radionuclides.
[2] ^{230}Th compares well with the alpha energy of ^{226}Ra and is slightly lower in energy so it is a conservative calibration/check source.
[3] ^{99}Tc is lower in energy than the beta emissions of ^{90}Sr/^{90}Y as well as the significant daughter products of ^{226}Ra so it is a conservative calibration/check source.
[4] ^{137}Cs has a gamma which is similar to the ^{214}Bi daughter and the response of the NaI detectors has been specifically calculated to ^{226}Ra and its daughter energies using the method of NUREG-1507.
[5] ^{230}Th is lower in energy than the ^{239}Pu alpha emissions so it is a conservative calibration/check source. Typically ^{239}Pu is determined by isotope specific laboratory analysis.
[6] ^{137}Cs has lower energy gamma emissions compared with 60Co; therefore it serves as a conservative calibration/ check source.

5.3 Definitions

TERM/ACRONYM	DEFINITION
Alpha Radiation (α)	Alpha particles (He^{+2}) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation. Alpha particles can pose an internal hazard if ingested or inhaled.
Background Radiation	Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building material, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. “Background” radiation does not include radiation from source, byproduct, or special nuclear material regulated by the Nuclear Regulatory Commission (NRC).
Beta Radiation	Beta particles (β) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.
Gamma Radiation	Photons emitted from the nucleus of most atoms during the radioactive decay process. Gamma rays do not have mass or electrical charge and can be very penetrating depending on their energy level. Gamma rays pose an external hazard.
Ionizing Radiation	Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
Mylar	Biaxial-oriented polyethylene terephthalate (boPET) is a polyester film made from stretched polyethylene terephthalate (PET) and is used for its high tensile strength, chemical dimensional stability, transparency, reflectivity, gas and aroma barrier properties and electrical insulation.

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

TERM/ACRONYM	DEFINITION
Photomultiplier Tube (PMT)	A sensitive detector of light in the ultraviolet, visible, and near-infrared ranges of the electromagnetic spectrum. These detectors multiply the current produced by incident light by as much as 100 million times in multiple dynode stages, enabling individual photons to be detected when the incident flux of light is very low.
Scintillator	Detector or scintillation counter is used when a scintillator counter is coupled to an electronic light sensor such as a photomultiplier tube (PMT) or a photodiode. PMTs absorb the light emitted by the scintillator and reemit it in the form of electrons via the photoelectric effect. The subsequent multiplication of those electrons (sometimes called photo-electrons) results in an electrical pulse which can then be analyzed and yield information about the ionizing radiation that originally struck the scintillator.
Sodium Iodide (NaI)	An inorganic alkali halide salt grown into a crystal with specific geometry used to detect gamma radiation via scintillation, when coupled with a photomultiplier tube.
Zinc Sulfide (ZnS)	ZnS is utilized as a scintillation detector, because it emits light on excitation by x-rays or electron beam, making it useful for x-ray screens and cathode ray tubes. It also exhibits phosphorescence due to impurities on illumination with blue or ultraviolet light. Silver activated zinc sulfide (ZnS(Ag)) has a very high scintillation efficiency but is only available as a polycrystalline powder and is thus used in thin screens for alpha particle detection.

5.4 Exposure Rate Meters

Exposure rate meters (Model 19, Model 9-3) will be pre operationally inspected and response checked in accordance with the following steps. Both background and source response shall be verified to be within the +/ 20% daily variability at the beginning of each work day the instrument is used.

5.4.1 Calibration Verification

All portable radiological instruments shall have an approved, current calibration label (Reference 3.3). Calibration verification shall be performed prior to the use of the instrument.

5.4.2 Physical Check

A physical check of radiological instruments is an inspection of the general physical condition of each instrument and detector. A physical check shall be performed prior to using a radiological instrument.

The physical check should include inspecting the instrument for loose or damaged knobs, buttons, cables, and connectors; broken/damaged meter movements/displays; dented or corroded instrument cases; punctured/deformed probe/probe window(s), cables, etc.; and any other physical impairments that may affect the proper operation of the instrument or detector. Any instrument or detector having a questionable physical condition shall not be used until the condition is properly corrected.

The instrument, cable, and detector as calibrated should be kept together as a unit. Do not swap components.

5.4.3 Battery Check

A battery check is performed to help ensure that there is sufficient voltage being supplied to the detector and instrument circuitry for proper operation. This check shall be performed in accordance with the instrument's technical manual.

5.4.4 High Voltage (HV) Check

The HV is adjusted during instrument calibration; additional adjustment for normal operation is not required. However, an HV check is required prior to each use in accordance with the specific instrument technical manual. For some instruments a HV check in the field is not possible. An instrument with suspected HV problems shall be immediately reported to the PRSO.

5.4.5 Response Source Check

A response source check is performed to ensure that the instrument will accurately respond to a known source of radiation. Using the ^{137}Cs source, perform the response source check as follows:

Step	Action
1	Determine the background radiation level. It must be low enough to allow a measurable response to the check source being used. Careful monitoring of changing background levels is necessary to obtain accurate instrument readings.
2	Begin with the instrument on the highest range/scale and energize the audible device, if applicable.
3	Slowly move the detector towards the check source and check the instrument for an increase in audible and/or visual response.
4	If appropriate check source(s) are available, change the range/scale of the instrument to obtain a visual indication and to check each of the meter ranges/scales. If an appreciable response cannot be obtained (even in the lowest range), evaluate instrument performance by comparison to previous source check data for the instrument. Notify the Project RSO of any instrument/detector response problems. Document the response on the Ratemeter Daily Instrument Check Sheet. Plot the response on the Control Graph at the bottom of the Ratemeter Daily Instrument Check Sheet.
5	The Project RSO or designee shall set up the control graph for background and source response on the Ratemeter Daily Instrument Check Sheet such that lines indicate when an instrument is outside of the +/ 20% variability.
6	Instruments with day to day background or source responses that vary by more than 20% under identical conditions shall be removed from service and the Project RSO shall be notified.

Ratemeter instrument inspections, performance verifications, and corrective actions shall be recorded on the Ratemeter Daily Instrument Check Sheet prior to use.

5.5 Sample Counters

Sample counters (Model 2929, Model 3030) will be prepared for use in accordance with the following steps:

5.5.1 Sample Counter Pre-Operational Requirements

Prior to the use of sample counters, the following inspections/operational verifications shall be performed in addition to those required in Section 5.4 for ratemeter type instruments (i.e., calibration verification, physical check, battery check, HV check).

5.5.2 Background Measurement (Initial Project Set-Up)

The following steps shall be performed during this activity:

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
1	Ensure that the sample holder tray is empty and clean. The detector/sample holder geometry should be set up in the same configuration as that to be used when counting samples to produce the most accurate results.
2	Select the desired counting time. The selected time must be consistently used to perform all source and sample/swipe counting operations. The counting time directly influences the Minimum Detectable Concentration (MDC) obtained for the instrument. Although the counting time must be long enough to obtain the desired MDC, it must be short enough to be practical. The background measurements should be performed in conjunction with the MDC calculations.
3	Perform the background measurement for the selected time period (t) and record the total counts measured on the Scaler Instrumentation Check Sheet.
4	Repeat the background measurement ten times. Record the total counts observed for each measurement on the Scaler Instrumentation Check Sheet.
5	5. Calculate the average background counts ( ) and the standard deviation (SDb): $\overline{C_b} = \frac{\sum_{i=1}^{N} C_{b_i}}{N}$ $SD_b = \sqrt{\frac{\sum_{i=1}^{N} (C_{b_i} - \overline{C_b})^2}{N-1}}$ Where: $\sum_{i=1}^{N}$ = Summation of item 1,2,3…N $\overline{C_b}$ = Average number of background counts SDb = Standard deviation of the background counts N = Number of measurements C_{b_i} = Background counts 1, 2, 3 … N
6	Record the average background ($\overline{C_b}$), background count time (t_b), and the standard deviation (SD_b) on the Scaler Instrumentation Check Sheet.
7	Divide $\overline{C_b}$ by t_b to determine the average background count rate in cpm ($\dot{C}_b$), and record the result on the Scaler Instrumentation Check Sheet.

Background is checked at the beginning of each work day the instrument is used. Acceptable background response is assessed using the following equation:

$$C_b = \overline{C_b} \pm 3SD_b$$

Where:

$\overline{C_b}$ = Average background counts.
SD_b = Standard deviation of the average background counts.

If the background measurement is satisfactory, continue. If the background measurement does not meet this criterion, immediately notify the PRSO. Record the background measurement on the Scaler Daily Instrument Check Sheet.

5.5.3 Source Response

Determine the detector source response with a source of known activity of a nuclide with energy decay products similar to those of the nuclide to be monitored (Table 2), as follows:

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
1	Correct the 4 pi source activity for radioactive decay (when necessary) as follows: $A = A_o e^{-\lambda T} \quad Where: \lambda = \frac{0.693}{t_{\frac{1}{2}}}$ Where: A = Present source activity. A_o = Source activity at initial assay. λ = Decay constant for the source isotope. T = Time elapsed since initial source assay. $t_{1/2}$ = Source isotope half-life. NOTE: Time units must be consistent (days, hrs, mins., etc.)
2	Count the source for the same time period (t_s) selected during the background measurements (See Section 5.5.2, step 2). Initially: At project set-up or as otherwise directed by the project specific work plans or instructions, or the Project RSO , count the source ten times and calculate the average net counts ($\overline{C_n}$), the standard deviation of the average gross counts (SD_g), and the standard deviation of the average net source counts (SD_n): $\overline{C}_g = \frac{\sum_{i=1}^{N} C_{g_i}}{N}$ $\qquad$ $\overline{C}_n = \overline{C}_g - \overline{C}_b$ $SD_g = \sqrt{\frac{\sum_{i=1}^{N} (C_{g_i} - \overline{C}_g)^2}{N-1}}$ $\qquad$ $SD_n = \sqrt{(SD_g)^2 + (SD_b)^2}$ Where: C_{g_i} = Gross source counts (total counts observed including background) 1 through N $\overline{C_b}$ = Average background counts. $\overline{C_g}$ = Average gross counts. $\overline{C_n}$ = Average net counts. SD_n = Standard deviation of the average net counts. SD_g = Standard deviation of the average gross counts. N = Number of measurements. SD_b = Standard deviation of the average background counts. $\sum_{i=1}^{N}$ = Summation of item 1,2,3…N. Record the gross counts (C_{g_i}, where i =1 to N), $\overline{C_n}$ and the standard deviations (SD_n and SD_g) on the Scaler Instrumentation Check Sheet.

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
3	Divide $\overline{C_n}$ by t_s to determine the average net count rate ($\dot{C}_n$) and record the rate on the Scaler Instrumentation Check Sheet. Source response is checked daily prior to instrument use. Acceptable source response is assessed using the following equation: $$C_g - C_b = C_n = \overline{C_n} \pm 3SD_n$$ Where: $\overline{C_n}$ = Average net counts C_g = Gross source counts C_n = Net source counts C_b = Daily background counts SD_n = Standard deviation of the average net counts $$SD_n = \sqrt{(SD_g)^2 + (SD_b)^2}$$

5.5.4 Instrument Efficiency (ε)

Record the 4 pi detector efficiency (ε) from the instrument Calibration Certificate on the Scaler Instrumentation Check Sheet

5.5.5 Calculation of Minimum Detectable Concentration (MDC)

The calculated MDC is determined to ensure that the detector being used will detect the presence of activity at or above the allowable limit under a given set of counting conditions. The MDC is the concentration that a specific instrument and technique can be expected to detect 95 percent of the time under actual conditions of use. MDC is based on the estimated detector efficiency, background, and the counting time.

MDC of each instrument shall be determined upon initial set up of the counting system and as needed following modification, calibration, repair, or replacement (i.e., new detector, cables, calibration, etc.). An MDC may be required to be adjusted based on specific materials that exhibit a different background than at initial set up.

For measurements of surface concentrations by a smear sample, the MDC_{static} should be determined using the equation from NUREG 1507. The sample collection times should be the same as the selected background times in Section 5.5.2, step 2, if practical. The PRSO shall consult with the License RSO for all other conditions.

Step	Action
1	Calculate the beta MDC for smears in dpm/100cm^2: $$MDC = \frac{3 + 4.65\sqrt{\overline{C_b}}}{(\varepsilon)(t)}$$ Where: $\overline{C_b}$ = Average background counts during time interval t t = Sample counting time, time interval in minutes

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
	ε = Efficiency for the emitted radiation
2	Calculate the alpha MDC for smears in dpm/100cm^2: $$MDC = \frac{3 + 4.65\sqrt{\overline{C_b}}}{(\varepsilon)(0.8)(t)}$$ Where: $\overline{C_b}$ = Average background counts during time interval *t* *t* = Sample counting time, time interval in minutes ε = Efficiency for the emitted radiation 0.8 = Alpha absorption factor for air and smear sample media
3	Calculate the alpha air sample MDC in µCi/mL: $$MDC = \frac{3 + 4.65\sqrt{\overline{C_b}}}{(\varepsilon)(Vol)(0.8)(t)(2.22E6)}$$ Where: $\overline{C_b}$ = Average background counts during time interval *t* *t* = Sample counting time, time interval in minutes ε = Efficiency for the emitted radiation *Vol* = The volume of air collected in mL 0.8 = Alpha absorption factor for air sample media 2.22E6 = Converts dpm to µCi
4	Record the calculated MDC values on the Scaler Instrumentation Check Sheet.

If the desired MDC cannot be attained, then inspect the instrument for equipment problems (contaminated detector or sample holder, loose cables/connectors, etc.) and notify the PRSO. If no equipment problems are found, parameters such as sample quantity, count time, or background radiation levels may have to be adjusted appropriately to obtain an acceptable MDC. An MDC that reliably satisfies the project release criteria, airborne activity requirements or remediation goals may be used. If reasonable adjustment of these parameters (as directed by the PRSO) does not result in an acceptable MDC, a more suitable instrument/detector shall be required.

Smear sample results are reported in disintegrations per minute per 100 centimeters squared (dpm/100 cm2); 2.22 dpm = 1 picocurie.

Air sample results are reported in microCuries per milliliter (µCi/ml).

Spreadsheet software is used to calculate instrument parameters (average background, source response, and MDC) and to track daily instrument performance checks. The PRSO or RCS will provide the instrument parameters to the RCTs via a printout or a label affixed to the meter.

5.6 Surface Contamination Survey Instruments

Ludlum Model 2360 or Model 2224 meters with either Ludlum 43 68, Ludlum 43 93 or Ludlum 43 37 detectors will be prepared for use in accordance with the following steps:

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

5.6.1 Surface Contamination Survey Instrument Pre operational Requirements

Prior to the use of these instruments and detectors, the following inspections/ operational verifications shall be performed in addition to those required in Section 5.4 for ratemeter type instruments (i.e., calibration verification, physical check, battery check, HV check). Where a calculator Standard Deviation Function is used or when a spreadsheet program is used in the pre operational checks, it should be noted on the affected paperwork.

5.6.2 Background Measurement (Initial Project Set up)

The following steps will be performed when conducting the initial background measurements as part of the instrument set up:

Step	Action
1	Select the desired counting time. The selected time must be consistently used to perform all source and sample counting operations. The counting time directly influences the Minimum Detectable Concentration (MDC) obtained for the instrument. Although the counting time must be long enough to obtain the desired MDC, it must be short enough to be practical. The background measurements should be performed in conjunction with the MDC calculations.
2	Perform the background measurement for the selected time period (t_b) and record the total counts measured on the Scaler Instrumentation Check Sheet.
3	Repeat the background measurement ten times. Record the total counts observed for each measurement on the Scaler Instrumentation Check Sheet.
4	Calculate the average background counts ($\overline{C_b}$) and the standard deviation (SD_b): $\overline{C_b} = \frac{\sum_{i=1}^{N} C_{b_i}}{N}$ $SD_b = \sqrt{\frac{\sum_{i=1}^{N} (C_{b_i} - \overline{C}_b)^2}{N-1}}$ Where: $\sum_{i=1}^{N}$ = Summation of item 1,2,3…N; $\overline{C_b}$ = Average number of background counts; SD_b = Standard deviation of the background counts; N = Number of measurements; C_{b_i} = Background counts 1, 2, 3 … N
5	Record the average background ($\overline{C_b}$), background count time (t_b), and the standard deviation (SD_b) on the Scaler Instrumentation Check Sheet.
6	Divide $\overline{C_b}$ by t_b to determine the average background count rate in cpm ($\dot{C}_b$), and record the result on the Scaler Instrumentation Check Sheet.

Background is checked at the beginning of each work day the instrument is used. Acceptable background response is assessed using the following equation:

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

$$C_b = \overline{C_b} \pm 3SD_b$$

Where:
C_b = Background counts
$\overline{C_b}$ = Average background counts.
SD_b = Standard deviation of the average background counts.

If the background measurement is satisfactory, continue. If the background measurement does not meet this criterion, immediately notify the PRSO. Record the background measurement on the Scaler Daily Instrument Check Sheet.

5.6.3 Source Response

Determine the detector source response with a source of known activity of a nuclide with energy decay products similar to those of the nuclide to be monitored (Table 2), as follows:

Step	Action
1	Correct the source activity for radioactive decay (when necessary) as follows: $A = A_o e^{-\lambda T}$ Where: $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$ Where: A = Present source activity. A_o = Source activity at initial assay. λ = Decay constant for the source isotope. T = Time elapsed since initial source assay. $t_{1/2}$ = Source isotope half-life. NOTE: Time units must be consistent (days, hrs, mins., etc.)
2	Count the source for the same time period (t_s) selected during the background measurements (See Section 5.6.2, step 2). Initially: At project set-up or as otherwise directed by the project specific work plans or instructions, or the Project RSO , count the source ten times and calculate the average net counts ($\overline{C_n}$), the standard deviation of the average gross counts (SD_g), and the standard deviation of the average net source counts (SD_n): $\overline{C}_g = \frac{\sum_{i=1}^{N} C_{g_i}}{N}$ $\overline{C}_n = \overline{C}_g - \overline{C}_b$ $SD_g = \sqrt{\frac{\sum_{i=1}^{N} (C_{g_i} - \overline{C}_g)^2}{N-1}}$ $SD_n = \sqrt{(SD_g)^2 + (SD_b)^2}$ Where: C_{g_i} = Gross source counts (total counts observed including background) 1 through N $\overline{C_b}$ = Average background counts.

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
	$\overline{C_g}$ = Average gross counts. $\overline{C_n}$ = Average net counts. SD_n = Standard deviation of the average net counts. SD_g = Standard deviation of the average gross counts. N = Number of measurements. SD_b = Standard deviation of the average background counts. $\sum_{i=1}^{N}$ = Summation of item 1,2,3…N. Record the gross counts (C_{g_i} , where i =1 to N), $\overline{C_n}$ and the standard deviations (SD_n and SD_g) on the Scaler Instrumentation Check Sheet.
3	Divide $\overline{C_n}$ by t_s to determine the average net count rate ($\dot{C}_n$) and record the rate on the Scaler Instrumentation Check Sheet. Source response is checked daily prior to instrument use. Acceptable source response is assessed using the following equation: $C_g - C_b = C_n = \overline{C_n} \pm 3SD_n$ Where: $\overline{C_n}$ = Average net counts C_g = Gross source counts C_n = Net source counts C_b = Daily background counts SD_n = Standard deviation of the average net counts $SD_n = \sqrt{(SD_g)^2 + (SD_b)^2}$

5.6.4 Instrument Efficiency (ε)

Record the 4 pi detector efficiency (ε) from the instrument Calibration Certificate on the Scaler Instrumentation Check Sheet.

5.6.5 Calculation of Minimum Detectable Concentration (MDC)

The calculated MDC is determined to ensure that the detector being used will detect the presence of activity at or above the allowable limit under a given set of counting conditions. The MDC is the concentration that a specific instrument and technique can be expected to detect 95 percent of the time under actual conditions of use. MDC is based on the estimated detector efficiency, background, and the counting time.

MDC of each instrument shall be determined upon initial set up of the counting system and as needed following modification, calibration, repair, or replacement (i.e., new detector, cables, calibration, etc.). An MDC may be required to be determined on specific materials that exhibit a different background than at initial set up. The Project

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

RSO shall be contacted to determine if an MDC determination is necessary for specific materials.

For scanning building surfaces, the MDC_{scan} for beta should be determined using the following equation (using a value recommended in Appendix A of U.S. Nuclear Regulatory Commission, NUREG 1757, Vol. 2, Rev. 1, "Consolidated NMSS Decommissioning Guidance," for the index sensitivity d' of 1.38, which is for 95 percent detection of a concentration equal to MDC_{scan} with a 60 percent false positive). The background collection times shall be at least 1 minute, to ensure consistent data collection.

For scanning alpha, the detection probability should be determined instead of the $MDC_{scan.}$ Further information discussed in section 5.6.6 below.

Step	Action
1	Calculate the beta MDC_{scan} in dpm/100cm^2: $$MDC_{scan}(surfaces) = \frac{1.38\sqrt{\overline{C_{bscan}}}}{(\sqrt{p})(\varepsilon)(t_{scan})(A/100\,cm^2)}$$ Where: 1.38 = Index of sensitivity *d'* $\overline{C_{bscan}}$ = Average background counts in time interval t_{scan} *p* = Surveyor efficiency (0.5) ε = Instrument 2pi (x surface efficiency of 0.5) for the emitted radiation t_{scan} = Sample count time, time interval of the observation while the probe passes over the source **<u>in minutes</u>**. *A* = Active area of probe in cm^2
2	Record the calculated beta MDC_{scan} on the Scaler Instrumentation Check Sheet.
3	For static measurements of surface concentrations by either direct measurement or by a smear sample, the MDC_{static} should be determined using the equation from NUREG 1507. The sample collection times should be the same as the selected background times in Section 5.6.2, step 2, if practical. The Project RSO shall consult with the License RSO for all other conditions.
4	Calculate the MDC_{static} in dpm/100cm^2: $$MDC_{static} = \frac{3+4.65\sqrt{\overline{C_{bstatic}}}}{(K)(t_{static})} = \frac{3+4.65\sqrt{\overline{C_{bstatic}}}}{(\varepsilon)(A/100cm^2)(t_{static})}$$ Where: $\overline{C_{bstatic}}$ = Average background counts during time interval t_{static} t_{static} = Sample counting time, time interval in min. the probe is in direct contact with the surface or smear *K* = ε*(A/100*cm*^{2}) A calibration constant (best estimate) to convert counts/min to dpm/100 cm^2. *A* = Probe's active area, in cm^2 ε = Instrument 2 pi efficiency (x surface efficiency of 0.5) for the

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
	emitted radiation
5	Record the calculated MDC_{static} on the Scaler Instrumentation Check Sheet.

The calculated MDC_{static} should be less than 50 percent of the appropriate project release criterion or remediation goal, and while there is no specific recommendation of MDC_{scan}, it should be no more than 50 percent of the appropriate project release criterion or remediation goal if possible. If the desired MDC cannot be attained, then inspect the instrument for equipment problems (contaminated detector or sample holder, loose cables/connectors, etc.) and notify the Project RSO. If no equipment problems are found, parameters such as sample quantity, count time, or background radiation levels may have to be adjusted appropriately to obtain an acceptable MDC. On a case by case basis an MDC that is greater than 50 percent but less than 90 percent of the project release criteria or remediation goals may be used with the concurrence of the License RSO. If reasonable adjustment of these parameters (as directed by the Project RSO) does not result in an acceptable MDC, a more suitable instrument/detector shall be used

Static counts are reported in dpm/100 cm2; 2.22 dpm = 1 picocurie.

Spreadsheet software is used to calculate instrument parameters (average background, efficiency, and MDC) and to track daily instrument performance checks. The PRSO or RCS will provide the instrument parameters to the RCTs via a printout or a label affixed to the meter.

5.6.6 Count Detection Probability for Alpha Scans

In accordance with the adopted process from the RASO guidance document *Conducting Alpha Scans for Radium*, the background should be evaluated to determine the applicable equation to be used to calculate the alpha count detection probability. The expected background response of alpha detectors varies from near zero to 10 cpm. Following sections cover to determine the alpha count detection probability of each instrument.

Step	Action
1	**Background counts ≤ 5 cpm;** For alpha survey instrumentation with background counts less than or equal to 5 cpm, a single count provides a surveyor sufficient cause to stop and investigate further. Assuming this to be true, the probability of detecting given levels of alpha surface contamination can be calculated by use of Poisson summation statistics. Given a known scan rate and a surface contamination release limit, the probability of detecting a single count while passing over the contaminated area is given by the following equation: $P(n \geq 1) = 1 - e^{\frac{-(G)(\varepsilon_i)(\varepsilon_s)(d)}{(60)(v)}}$ Where:

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action

$P(n \geq 1)$ = probability of observing a single count

G = surface contamination release limit (dpm)

ε_i = detector efficiency (2π)

ε_s = surface efficiency 0.25

d = width of detector in direction of scan (cm)

v = scan speed (centimeters per second)

A probability of detection should be as close as practicable to 90%, but shall not be ower than 68%.

Background counts > 5 cpm;

The larger (584 cm2) gas proportional detectors have alpha background count rates on the order of1 cpm to 10 cpm. If the background counts is less than or equal to 5 cpm, a single count will not cause a surveyor to investigate further. A counting period long enough to establish that a single count indicates an elevated contamination level would be prohibitively inefficient. For an instrument with lower background, the surveyor usually will need to get at least two counts while passing over the source area before stopping for further investigation.

Assuming this assumption is valid; the probability of getting two or more counts can be calculated by equation:

$$P(n \geq 2) = 1 - \left[1 + \frac{(G\varepsilon_i\varepsilon_s + B)t}{60}\right]\left[e^{\frac{-(G\varepsilon_i\varepsilon_s + B)t}{60}}\right]$$

Where:

$P(n \geq 2)$ = probability of getting two or more counts during the time interval t

t = time interval of detector over source (seconds)

G = surface contamination release limit (dpm)

ε_i = detector efficiency (2π)

ε_s = surface efficiency 0.25

B = background count rate (cpm)

A probability of detection should be as close as practicable to 90%, but shall not be lower than 68%.

Once a count is recorded and the guideline level of contamination is present, the surveyor should stop and wait until the probability of getting another count is at least

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
	68 percent. This time interval can be calculated by the following equation: $$t = \frac{13,800}{CAE}$$ Where: t = time period for static count(s) C = surface contamination release limit (dpm/100 cm^2) A = physical probe area (cm^2) E = detector 2 pi efficiency (x surface efficiency) Alpha scan rate of 1.00 cm/second will be employed for Ludlum 43-93 (or equivalent) detector and 1.25 cm/second will be employed for Ludlum 43-37 (or equivalent) detector. The PRSO or RCS will determine the time period required for each instrument specific probability time interval, and document it on a printout or a label applied to the meter.
2	Record the calculated alpha count detection probability and the time period on the Scaler Instrumentation Check Sheet.

5.7 Gamma Survey Instruments

Ludlum Model 2221 or equivalent meters with either Ludlum 44 10 or Ludlum 44 20 detectors are only used to identify potential anomalous gamma count rates due to the presence of low-level radiological objects or soil contamination (resulting from either direct gamma emissions or bremsstrahlung due to beta emissions). Count rate measurements acquired using the 44 10 and 44 20 are not used in determining soil activity concentrations of radionuclides of concern, but may be used to develop estimates for potential exposure or health risk.

Ludlum Model 2221 or equivalent meters with either Ludlum 44 10 or Ludlum 44 20 detectors will be prepared for use in accordance with the following steps.

5.7.1 Background Determination

The following steps will be used in determining background count rates for gamma scintillation detectors during instrument quality control checks:

Step	Action
1	Set the counting time to one minute.
2	Perform the background measurement for the selected time period (t_b) and record the total counts measured.

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
3	For initial instrument setup, repeat the background measurement ten times. Record the total counts observed for each measurement.
4	Calculate the average background counts ($\overline{C_b}$) $$\overline{C_b} = \frac{\sum_{i=1}^{N} C_{b_i}}{N}$$ Where: $\sum_{i=1}^{N}$ = Summation of item 1,2,3…N $\overline{C_b}$ = Average number of background counts N = Number of measurements C_{b_i} = Background counts 1, 2, 3 … N
5	Divide $\overline{C_b}$ by t_b to determine the average background count rate in cpm ($\dot{C}_b$), and record the result.

Daily: perform a single background count (C_b) prior to instrument use. Analyze this value using the following formula:

$$C_b = \overline{C_b} \pm 20\%$$

Where:

$\overline{C_b}$ = Average background counts

Record the background measurement. If the background measurement is satisfactory, continue. If the background measurement does not meet this criterion, immediately notify the PRSO.

5.7.2 Source Response

The following steps will be used in determining background count rates for gamma scintillation detectors during instrument quality control checks:

Step	Action
1	Set the counting time to one minute.
2	Place the ^{137}Cs check source under the source check jig and the detector into the jig, ensuring the source to detector distance is 10 cm (4 in).
3	Perform the source measurement for the selected time period (tb) and record the total counts measured.
4	For initial instrument setup, repeat the source measurement ten times. Record the total counts observed for each measurement.
5	Calculate the average background counts ($\overline{C_s}$)

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

Step	Action
	$$\overline{C_s} = \frac{\sum_{i=1}^{N} C_{si}}{N}$$ Where: $\sum_{i=1}^{N}$ = Summation of item 1,2,3…N; $\overline{C_s}$ = Average number of source counts; N = Number of measurements; C_{s_i} = Source counts 1, 2, 3 … N
6	Divide $\overline{C_s}$ by *t* to determine the average source count rate in cpm ($\dot{C}_s$), and record the result.

Daily: prior to instrument use, perform a single source count (C_s) in the same geometry employed for determining the initial source response. Analyze this value using the following formula:

$$C_s = \overline{C_s} \pm 20\%$$

Where:

$\overline{C_s}$ = Average source counts

Record the source measurement. If the source measurement is satisfactory, continue. If the source measurement does not meet this criterion, immediately notify the PRSO.

5.7.3 Reference Area Background Determination

Initially, for each gamma survey instrument designated for soil investigation use, perform a survey of the designated reference area identified by the PRSO in consultation with the client in accordance with CMS-710-07-WI-40122 Gamma Walkover Survey Using Global Positioning System or other project-specific survey method.

Data collection will include scan data for the entire reference area and a minimum of 20 1-minute static counts collected within the reference area at a probe height of 10 cm. The location of the static counts will be determined by applying a systematic grid over the reference area using a random starting coordinate.

The scan data and the static measurements will be compiled and a mean count rate for static counts will be determined using spreadsheet and scan counts will be determined using the GIS software, and the standard deviation for each will be calculated.

Investigation levels for scans (mean of the scan data set plus 3 standard deviations) and investigation levels for static measurements (mean of the static data set plus 3 standard deviations) will be calculated for each gamma survey instrument in use. The PRSO or RCS will provide the RCTs with the instrument parameters and investigation levels on a spreadsheet printout or a label affixed to the meter.

D2005-0008-004
Operation and Use of Portable Instruments at Hunters Point Naval Shipyard

CMS Number:	Revision:	Approval Date:
N/A	0	6/27/16

5.7.4 Performance of Gamma Surveys

Surveys with the Ludlum 44 10 or Ludlum 44 20 detectors are used to identify areas of elevated gamma counts that may be the result of radiological objects or contamination. Locations identified during scanning that exceed the instrument specific investigation level require further investigation. Initial investigation will consist of reacquiring the elevated location and conducting a 1 minute static count. Also the RCT will rescan the nearby vicinity to assess if the elevated reading is the result of a point source or distributed radioactive material. If the static count is less than the static investigation level and there is no evidence of a point source, further investigation is not required. If the static investigation level is exceeded or there is evidence of distributed contamination at or above either investigation level the area will be flagged for further intrusive investigation.

5.7.5 Calculation of Scan Minimum Detectable Concentration (MDC)

The following presents an example calculation of minimum detectable count rate and corresponding scan MDC for soil. Additional calculations should be performed as necessary as conditions change to confirm expected scan sensitivities.

The minimum detectable number of net source counts in the scan interval, for an ideal observer, can be determined by multiplying the square root of the number of background counts (b_i) (in the scan interval) by the detectability value (d') associated with the desired performance as shown as follows:

$$MDCR = d'\sqrt{(b_i)}\left(\frac{60}{i}\right)$$

Where:

d' = index of sensitivity (α and β error)

bi = number of background counts in scan time interval (count)

i = scan or observation interval(s)

The following is an example calculation of the minimum detectable count rate (MDCR) in cpm for a typical Ludlum Model 2221/44-10 setup. It was noted that a typical source remained under the probe for 2 seconds during the scan; therefore, the average number of background counts of 6,378 cpm (reference area mean count rate for all scan instruments used) in the observation interval of 2 seconds was 212.6 cpm (b_i = 6,378 × [2/60]).

The performance goal for scanning surveys requires a rate of 95 percent for true positives and 5 percent for false positives. From Table 6.5 of MARSSIM (DoD et al., 2000), the value of d', representing this performance goal, is 3.28.

Using these inputs, the MDCR is:

$$MDCR = 3.28\sqrt{(212.6)}\left(\frac{60}{2}\right) = 1435\ cpm$$

The MDCR including surveyor efficiency ($MDCR_{Surveyor}$) can be calculated using a surveyor efficiency (P) of 0.50 and using the following equation:

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}} = \frac{1435}{\sqrt{0.50}} = 2029\ cpm$$

The gamma scan MDC (in pCi/g) for land areas is based on the area of elevated activity, depth of contamination, and the radionuclide (i.e., energy and yield of gamma emissions). To establish the scan MDC, the relationship between the detector's net count rate to net exposure rate must be established. The initial step in this process is determining the $MDCR_{Surveyor}$ as shown in preceding paragraphs.

The corresponding minimum detectable exposure rate (MDER) is determined for a 2-inch by 2-inch NaI probe and the ROC. Manufacturer specifications for the Ludlum 44-10 indicate a cpm to microroentgen per hour (μR/hr) rate of 900 for ^{137}Cs. This value converts to a calibration constant of 5.4E10 counts per R. An exposure rate can be calculated for a given count rate and vice versa using the following equation:

$$MDER\left(\frac{\mu R}{hr}\right) = \frac{MDCR_{Surveyor} \times 6E07}{cc}$$

Where:

$MDCR_{Surveyor}$ = 2029 cpm

cc = calibration constant = 5.4E10

6E07 = conversion factor accounting for differences in time and activity units (μR-min)/(R-hr)

The MDER for ^{137}Cs and ^{226}Ra calculated in the manner described above is 2.25 μR/hr.

Modeling (using MicroShield Version 5.05 [Grove Engineering, 1996] or similar software) is used to determine the net exposure rate produced by 1.0 pCi/g of ^{226}Ra and its daughter products after 30 years of ingrowth in soil.

- The physical and geometrical factors considered in the modeling included:
- The exposure point of 4 inches above the soil was used.
- The density of 1.6 grams per cubic centimeter was used for soil.
- The depth of the area of elevated activity was 15 centimeters.
- The circular dimension of the cylindrical area of elevated activity was 0.25 m^2.

Using the above input parameters, MicroShield Version 5.05 (Grove Engineering, 1996) calculates the exposure rate to be 0.7384 μR/hr for ^{226}Ra (accounting for buildup). The radionuclide concentration of ^{226}Ra necessary to yield the MDER of 2.25 μR/hr is the scan MDC and may be calculated as follows:

$$^{226}Ra\ Scan\ MDC = \frac{1.0\,\frac{pCi}{g} \times 2.25\,\frac{\mu R}{hr}}{0.7384\,\frac{\mu R}{hr}} = 3.05\ pCi/g$$

This value is consistent with the default value of 2.80 pCi/g for a ^{226}Ra soil source reported in NUREG-1507.

Site-specific scan MDCs were not modeled for ^{137}Cs; rather the default value from NUREG-1507 is used. The reported default scan MDC for a 2 by 2 NaI from NUREG-1507 is 6.4 pCi/g for ^{137}Cs.

6.0 ATTACHMENTS

None

APPENDIX E
PROJECT QUALITY CONTROL MANAGER AND ALTERNATIVE PROJECT QUALITY CONTROL MANAGER LETTERS OF DESIGNATION

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Project Construction Quality Control Manager

Letter of Designation

Contract Number: N62473-17-D-0006, Contract Task Order: N6247321F5082

Basewide Operation, Maintenance and Radiological Support at Hunters Point Naval Shipyard, San Francisco, California

February 2022

Mr. Michael Lightner:

This letter will serve to assign you as the Aptim Federal Services, LLC Project Quality Control (QC) Manager for the above-captioned contract task order. In this capacity, you will report directly to me and will administer the established requirements of the contract and Project QC Plan. In the case where you are not able to perform the Project QC Manager's duties, Mr. Kevin O'Leary, Mr. Lee Laws, Mr. Edgar Ruiz, Ms. Lyndsey Becotte and/or Mr. Kevin Hoch will serve as your Alternate Project QC Manager. You will manage the three phases of control. You are authorized to stop work that is not in accordance with the contract and will exercise this authority consistent with Aptim Federal Services, LLC policies and procedures. You are authorized to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work.

Your Construction Quality Management certificate and resume are classified as Personal Identifiable Information and not included in the Project QC Plan. These records will be furnished to the government upon request.

If you have questions or require additional information, please contact me at 415.572.1814.

Sincerely,
Aptim Federal Services, LLC

Kevin Hoch
Program QC Manager

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Alternate Project Construction Quality Control Manager

Letter of Designation

Contract Number: N62473-17-D-0006, Contract Task Order: N6247321F5082

Basewide Operation, Maintenance and Radiological Support at Hunters Point Naval Shipyard, San Francisco, California

February 2022

Mr. Kevin O'Leary, Mr. Lee Laws, Mr. Edgar Ruiz, Ms. Lyndsey Becotte, Mr. Kevin Hoch:

This letter will serve to assign you as the Aptim Federal Services, LLC Project Quality Control (QC) Manager for the above-captioned contract task order. In the case where the designated Project QC Manager, Mr. Michael Lightner is unable to perform the Project QC Manager's duties, you will serve in that capacity with his responsibilities and authorities, report directly to me, and administer the established requirements of the contract and Project QC Plan. You will manage the three phases of control. You are authorized to stop work that is not in accordance with the contract and will exercise this authority consistent with Aptim Federal Services, LLC policies and procedures. You are authorized to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work.

Your Construction Quality Management certificate and resume are classified as Personal Identifiable Information and not included in the Project QC Plan. These records will be furnished to the government upon request.

If you have questions or require additional information, please contact me at 415.572.1814.

Sincerely,
Aptim Federal Services, LLC

Kevin Hoch
Program QC Manager

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